1250

GRANULAR BUTTER.

SCIENTIFIC DAIRY PRACTICE;

—OR—

HIGHEST QUALITY.
ECONOMIC PRODUCTION.
SYSTEM IN MARKETING.
=
Profitable
Dairy
Agriculture:

—FOR—

CANADIAN FARMERS.

BY

W. H. LYNCH.

(ILLUSTRATED.)

Ottawa:
A. S. WOODBURN.
1886.

St Alban Creamery 1893 1

19.380 lbs of butter
this one day

SCIENTIFIC DAIRY PRACTICE;

—OR—

Profitable Dairy Agriculture

FOR CANADIAN FARMERS.

J. N. Allard
Stanstead
1886

—BY—

WILLIAM H. LYNCH.

(ILLUSTRATED.)

> "*He asked water and she gave him milk, she brought forth butter in a lordly dish.*"
> JUDGES V. 25.

PUBLISHED WITH ASSISTANCE FROM THE PARLIAMENT OF CANADA.

Ottawa:
A. S. WOODBURN.
1886.

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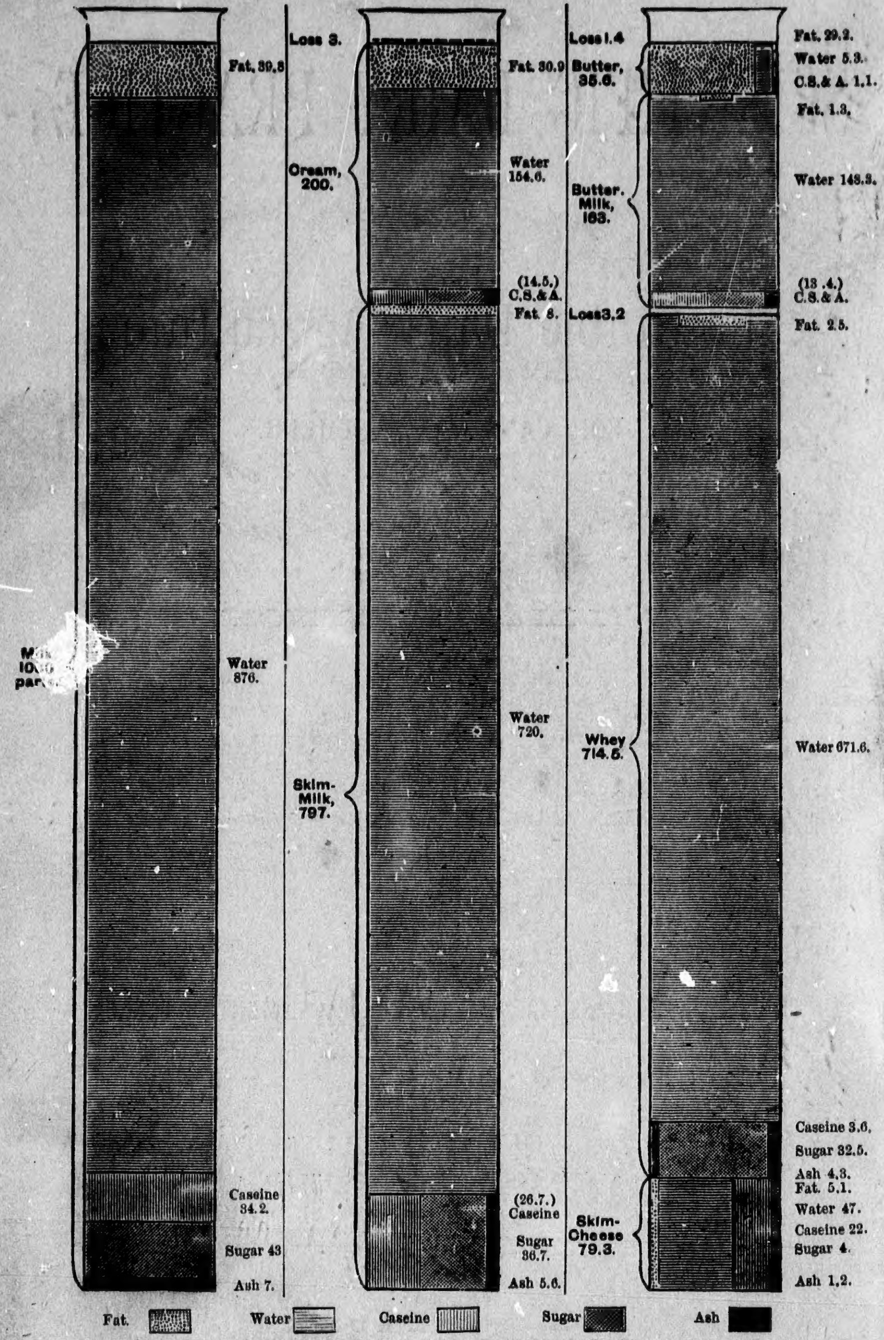


MILK—Its Products—Constituent Parts—Specific Gravities.

Entered according to Act of Parliament of Canada, in the year one thousand eight hundred and eighty-six, by W. H. Lynch, in the Office of the Minister of Agriculture and Statistics, Ottawa.

SCIENTIFIC DAIRY PRACTICE.

PREFATORY.

SCIENCE is a knowledge of facts and a systematic use of that knowledge. **Practice** is the habit by which a certain work is done, or a certain process is carried out. A **Scientific Practice** is one based upon known facts, and is, consequently, an intelligent practice. A practice that is unscientific is one of mere habit that has no reason to give for itself other than that it is the way accustomed. The results are in the one case certainty, and in the other case chance.

Dairy Science has shared with other science in a marked progress during the last quarter-century. The knowledge extant to-day, and available as science, covers the whole ground of dairy practice—that of **Milk Production**, and the **Manufacture of Dairy Products**. There is science in the *Selection and Breeding of Dairy Cows;* in the *Fertilization and Cultivation of Land;* in the *Growing of Cattle Feed*, and the *Economical Feeding of Stock;* in the *Care and Management of the Dairy*, and the *Manufacture of Butter and Cheese.*

Dairy Practice has not kept pace with the advance of scientific knowledge. There are dairymen who are still following practices that have been wholly given up by their more advanced competitors, and practices for which there can be only one excuse—lack of knowledge of something better. Even among advanced dairymen there are practices still in vogue that would be improved by further light from dairy science.

Butter and cheese, either, may be made by rule-of-thumb, and a good article be produced; but both are better and more easily made by rule-of-reason. The judgment that comes of long experience, combined with long practice, certainly produce good results; but the combination is too rare to promise much general success, in either branch of dairying. Happily, ordinary judgment and moderate skill, in the application of a scientific method, involving the use of best mechanical helps, will do even more than can be done by uncommon judgment and great skill, applied to a crude, chance process.

The advantages of an **Improved Practice** or of scientific method are absolutely essential, in these days of general progress, to successful competion in the world's markets; and that fact affords ample scope for this elementary practical work, which has for its object the practical one of making a better **Scientific Knowledge** helpful to a more **Profitable Practice.**

To give this book as much as possible a practical character and value, it will be written from the point of view of the dairyman, whose living is made by keeping cows. Not all dairymen can be scholars, nor even close students, for which reason an effort will be made to write in language and style so simple that the meaning may be clear to the most ordinary reader. As the dairyman will always be seeking to make profit out of his cows, every sentence will be written for readers whose question of merit will be "**Will it Pay?**"

Profitable Dairying to-day, involves the necessity of successful competition with all other dairying. Keeping this in mind, our subject naturally divides itself into two divisions: (1) *Increasing the market value of the product.* (2) *Lessening the cost of production.*

PART I.

INCREASING THE MARKET VALUE OF THE PRODUCT.

THE Profit from the dairy depends first upon the **Market Value** of the dairy products. Market value depends upon two things—the *quality* of the products offered, and the *supply.*

There are dairy goods sold in the market so low that they cannot pay the cost of production, however cheaply they may have been produced. On the other hand, there are goods sold at so high a price that there must be a considerable profit therefrom, even though the cost of production be unduly high. Butter, for instance, is being sold every day at prices ranging from six cents to one dollar per pound. None of it has been produced at six cents; and the cost of producing the very finest article must have been low enough to leave a very good profit at even less than one dollar per pound.

Improve the Quality. Quality is the first necessity of every marketable product, but it is more than ever a necessity in butter and cheese. Compare one of these products with another farm product, say one of the cereals; compare, for instance, butter with wheat. Wheat is an ordinary necessary; butter is mainly a luxury, it is only as a luxury that it becomes a necessary at all. When it ceases to be a luxury, it soon ceases to be a necessary. Butter remains a luxury only so long as its quality is good; when the quality depreciates to a certain degree, the created appetite for it is not satisfied, and demands a substitute or nothing. The demand for butter, therefore, in a far different sense than that for wheat, depends upon the character of the article supplied. Again, there is a difference in the value of different samples of wheat; but the difference is slight compared to that of different lots of butter, which varies in its quality not ten, or even fifty, but several hundred per cent. The value of wheat may be decided easily at sight, almost by mere weight; the quality of butter can be determined only by careful examination and test, and even then only to a degree. The keeping quality of a sample of butter cannot always be known even by an expert. Butter cannot, like wheat, be stored or transported, and with little risk of depreciation; it requires special precautions and is liable to serious depreciation in value. Butter, unlike wheat, has to suffer competition, late years, with a substitute, oleomargarine, butterine, &c., which closely imitates the original, and deceives the buyer. These considerations are of value to those for whom must be emphasized the special need of **Quality** in the profitable production of dairy goods.

Quality is so much dependent upon the manufacture of milk products that the process of manufacture will be described in this connection.

MILK. Too much stress cannot be laid upon the fact that milk **Must be Pure**. Impurities in milk affect unfavorably not only the value of its products as articles of diet, but the very processes which give the products. For instance, the drinking by the cows of impure water, the dropping of impurities into the milk itself, not only render the milk an improper diet, but make more difficult and unsatisfactory the manufacture of milk products therefrom. While milk is extremely sensitive to odors or taints of any kind, the animal source of milk makes it especially subject to chances of contamination. The health of the cow, what she eats or drinks, the kind of treatment to which she is subjected, will affect the milk for good or ill, even before it is drawn from the udder. The surroundings of the milk while it is being drawn are always more or less unfavorable to purity and cleanliness. Even while milk is being secreted it is liable to taint. Instances are many where milk has been known to take in impure odors through the breath of the cow. A cow is feeding near an onion patch and her milk is spoiled. A writer in the Chicago *Live Stock Journal* gives an instance where twelve cows were subjected to the scent of a dead calf that was lying twelve rods from the lane through which the cows passed. The exposure of the cows to the tainted air was but one minute twice daily, but the effect was to nearly spoil for cheese-making the milk of eighty-five cows, with which the tainted milk was mixed! The burial of the calf removed both the cause and the effect. Cheese—the whole make of the factory—is frequently injured by the cows of one or more dairies inhaling the air from decaying matter lying about the barns.

The Causes of Imperfect Milk. The chief difficulty in securing good and pure milk is its extreme sensitiveness, already alluded to. The whole stage of its existence is critical. Any infection taken, by the **Breathing**, into the lungs of the cow is carried at once into the circulation, then into the blood, and taken up by the milk as it is secreted. Perhaps there is no single cause of impure odors so frequent as **Confined Air in Stables**, especially in cold climates, where stables are kept tight-closed for sake of warmth, the stables being warmed by the heat from the animals. The perspiration, the excrement and the used-up air, all make foul breathing that quickly affects milk. To guard against this, the stables should be provided with means af thorough **Ventilation**, and should have a thorough airing with open doors when the cattle go out for exercise, which they should be allowed to do whenever the weather is mild enough. The stable should be kept clean, and an abundance of absorbent material, such as cut straw, saw-dust, muck, etc., kept upon the floor to soak up the liquid. It would be well to use plaster occasionally, to spread upon the floor, both because of its manurial and its sanitary value.

Bad Food will produce impure milk. **Food and Water** are the raw material from which milk is directly manufactured. If the raw material be poor the product will be faulty. **Wholesome Food** and **Pure Water** are absolutely essential to the production of good milk. In the **Pasture**, swamp weeds, wild onions, and other sorts of wild weeds, injure the quality of the milk; and in the **Stables**, turnip tops, cabbages, and even half-ripe potatoes, in any considerable quantities, do likewise. But if these are injurious, what shall be said of tainted food—partly or wholly decomposed! Hide it as one may to deceive the cow, it will show itself in the milk.

Of all injurious foods one of the worst, and most preventible, is **Foul Water**. Milk is about 87 parts water; and this water if foul when drank will not be pure when yielded up to the milker. See that the pastures are all right. If the land is swampy and cannot be drained it is not fit for cattle; but if it must be used it might at least be separated from the main pasture, and pastured by stock that is not yielding milk. Root out all rank-smelling weeds from the pasture proper, even though the doing of it involve considerable labor.

Ill-health is another cause of impure milk. Not only is chronic disease unfavorable to milk-production, but even a momentary derangement of the internal organization will quickly show itself in the milk. When a cow is worried by a dog, or abused by any brute, be he quadruped or biped, the milk is at once affected. The periodic disturbance in the system due to the provision for reproduction of the species, known as seasons of "**Heat**," are really conditions of temporary ill-health, and have a marked effect upon the milk. The quality of the milk at such times is more or less deteriorated, and sometimes the quantity is diminished, how much will depend something upon the disposition of the cow. Fleischman goes so far as to say that such milk should not be accepted at the cheese-factory. See that everything in the care and keeping of cows conduces to good health. If the cow is actually diseased, throw milk away. Where milk is doubtful, do not mix it with milk to be used.

When milk is faulty it will be well to subject it to a high heat, which will help to purify it. If the milk does not coagulate in boiling it may be used. Milk that is affected by casual causes, such as excessive heat, cold, or other like bodily discomfort, or accidental access to foul water, often may be corrected by subjecting it to a heat of 140° Fahrenheit. The milk afterwards, when cooled, may be used in dairy processes.

Milk as an Absorbent. All liquids are ready absorbents of odors or impurities of the atmosphere. Milk is 87 per cent. liquid. The readiness with which milk will absorb impurities and the evil effect upon it of such absorption, is not fully appreciated. The time when milk is the most absorbent is when it is *colder* than the *surrounding medium.* The greater the degree of difference, the more rapid the absorption. When milk is *warmer than the air surrounding*, and consequently cooling down, it is less absorbent, for then it gives out, rather than takes in, impure odors. This is fortunate, for it saves, partially at least, the milk which is drawn in ill-odored stables. The odors found in milk that is quickly removed from stables, come, doubtless, not by direct absorption but *through the breathing of the cow*, or from something falling into the milk. But when milk cools down near to, or below, the temperature of the air or liquid which surrounds it, it becomes an absorbent. This demands quick removal from milking place, and setting in a pure atmosphere.

Another potent cause of milk deterioration is **Uncleanliness in Dairy**, or **Ill-Cleansed Milk-Vessels.** Milk contains living germs which are an active cause of decomposition. Wherever milk touches it is likely to leave the seeds of these ferments to spring into activity at the first chance. Milk falling upon the floor taints the atmosphere; and the ferments left in the pores or cracks of vessels, remain there to rapidly develop in the next milk poured into the vessels. It is wonderful how rapidly a cause apparently so slight will hasten the decomposition of milk. It is because of this fact that every successful dairy is characterized by a scrupulous care that might be termed fastidiousness, were it not truly a question of good or bad results, profit or loss.

The first requisite in the **Management of Milk**, at the beginning, throughout, and at the end, is **Cleanliness**. All the milk-vessels from milking-pail to packing pestle must be kept scrupulously clean.

Washing Milk-Vessels. The cleansing of milk-vessels must follow not alone the same day nor the same hour, but immediately after their use. It is not possible to cleanse milk-vessels so easily or so well after the dirt has dried on and in them, as when they are still fresh and damp after use. If sometimes a slight delay be necessary, let the vessels in the meantime be filled with, or plunged into, cold water. If water be not abundant, let the vessels be rinsed immediately, and a little of the rinsing water left in each. This, on the whole, will not be extra labor. For the first washing of milk vessels hot water should never be used. The first water should be either cold or only slightly warm. Scrub the vessels well, in the first washing, to free them from most of the solid matter, which adheres to their surface. Where the vessels are oily or greasy, which they will be when cream has adhered to the sides, they should be washed with water not scalding, but warm enough to melt the oil. The vessels should now be scalded and rinsed, using a mop cloth, a swab, or a suitable brush, to rub the vessels and save the hands. The vessels may then be quickly emptied and drained in a warm place.

If the rinsing water be as hot as it should be, and abundant, and the draining done quickly, no wiping is required. Where a towel is used, however, a clean one is required for every washing. Air the vessels outside, whenever practicable, in the free air and sunshine. When milk has soured in the vessels, or the washing has been delayed, greater care is needed in washing. It is the practice of some good dairy people to give an occasional sweetening wash to the milk-vesels, using soda, or soap, or lime, or lime and ashes, or nettles, etc. It is well, however, to remember that when any chemical is used in the cleansing of milk-vessels, the rinsing of the vessels should be thorough so as to wholly *remove all trace* of such chemical, for its presence may give trouble in the cream-rising, and the churning.

A practice to be commended is that of occasionally boiling the milk vessels for, say twenty minutes or half an hour, and drying them over a moderate fire. A mop, or swab, should be so constructed that it can be easily cleansed by washing, and afterwards hung up to dry. A cloth mop with a short handle will do.

A good **Sink** would be a convenience in every dairy. One or two large pans made to fit in the sink and to take up one third or half the space of the sink would be a great convenience for washing and rinsing vessels. One or two cheap oil-cloth mats, or the more expensive rubber mats, are valuable adjuncts to the dairy or wash-room. Another convenience would be a cheap, plain rack for draining and drying vessels. It is no economy to stint one's self in providing any conveniences for washing dairy vessels which would make a saving of time and labor, and secure cleanliness.

The towels used for wiping dairy utensils should be renewed at each washing. It is less trouble to wash many lightly-soiled towels than a few badly-soiled ones; but if it were not so it would still be useless to try to cleanse *milk*-vessels with towels used at previous washings.

MILKING—Milking-Vessels. Any material that is porous, and will soak up a liquid, is absolutely unfit for use as milking-pails. Wooden pails should never be so used. The pores of the wood become impregnated with the seeds of fermentation, and cause rapid decomposition of milk whenever they are used. A party belonging to the Geological Survey recently found themselves camping in a district where it was the practice to milk in wooden pails, and it was found that the milk bought from the farmers would sour in the camp in three hours! Tin is a good material for milking-pails, but it should be of good quality, and well made up, with seams, if any, few and smooth.

The **Milking Place** should be well ventilated, and the floor clean and dry. If in a stable, spread straw, or other absorbent, under the cows, to prevent spattering. Owing to the necessary association of the milk with the animal producing it, and to the essential surroundings, it is required, in order to obtain pure milk, that more than ordinary care be taken during the whole operation. Water, dirt, or hairs dropping from the body, dirt spattering up from the floor, impure odors, where milk is long exposed, all must needs be guarded against. Before milking, all loose hairs should be brushed off the side of the cow.

Above all, see that the udder and teats are clean. Where the cow has been well bedded and carded, and has been properly milked at previous times, it is comparatively little work to prepare the udder. Wipe thoroughly the udder and each teat, using a dry cloth, or soft hay, or straw, or green grass, or a brush, or even waste paper. Where this will not remove the dirt, the udder should be washed, *not with milk* but with *clean water*, and wiped *thoroughly dry* before beginning to milk. Rather than to wash the udder, and to milk before the udder is quite dry, it would be better merely to wipe off the dirt with hay, or a rag. The worst of all dirt to fall in milk is dirt that trickles down in liquid form. It cannot be strained out. It is more pleasant, as well as more cleanly, to milk clean, dry teats with clean, dry hands.

At the best it is difficult to make the teats as *clean at the beginning* as they are *after milking is done.* The dandruff works off by the act of manipulation. Therefore, to further secure against dirt in milk, it is well before milking to manipulate the teats, pressing them all they will bear without causing a flow of milk, and brushing the loose dandruff off with the hand. This will remove much loose skin and effete matter that would otherwise loosen during the milking, and fall into the pail. This is not lost labor, even if done for another purpose; it will *stimulate milk secretion* and cause the milk to come more freely when the flow begins. Hold the pail a little outside from under the udder. The ends of the teats should not be neglected. There is dirt sometimes accumulated in the cavity. It will be no loss to the dairy if the first few drops be not saved. This first milk will be poor in fat, while it is liable to hasten the souring of the whole milk. It will pay not to draw it into the milking pail, although it may easily be saved in another vessel, if thought worth while, for calves or pigs.

Milking. The milker, provided with a good and solid stool for a seat, draws himself close up to the cow, his right side towards her head. If his pail does not hold a full milking, the milker has within easy reach, vessel room to hold all that the cow will give, so that he need not rise before he is done. The left arm is held near the leg of the cow as a protection for the pail, should the cow raise her foot. The right hand grasps one forward teat, the left hand taking the hind teat on the opposite side. Grasp the teats close to the udder, pressing the fingers, *from the first finger downwards*, with a firm, gentle pressure, forcing the milk down steadily, but rapidly. Change teats a few times so as to relieve the pressure on the full ones. Study the comfort of the cow, and stop only when all the milk has been drawn.

Care of the Milk. Carry the milk to a convenient place, where the atmosphere is pure, and there strain it, either into a carrying or milk-setting vessel.

A cloth strainer, when it is a good one, and care is taken to keep it clean, is to be preferred to the wire strainers. If one uses a wire strainer, add a cloth strainer and so make it a double strainer. The writer has frequently seen milkers run several milkings through a single strainer, leaving froth and dirt to accumulate therein, and much of it to be forced through into the milk. This froth should be *thrown out of the strainer*, every time a pail of milk has been poured through it.

Butter-Making. Milk contains a percentage of fat, in the form of minute particles, too small to be visible to the naked eye. These particles, or globules, as they are called, are not chemically combined with the other constituent parts of the milk, but are mechanically suspended in the milk, and therefore move freely from place to place in the milk. These globules are, as it were, a foreign substance in the milk, as fine dust would be in any liquid.

It is the presence of this fat in milk that gives to milk its **Butter-Making Quality**. These fatty particles, being lighter than the milk itself, have a constant tendency to rise to the surface, there to remain, more or less mixed with the milk. The fat does not all rise to the surface, for a part of it remains in the lower portion of the milk. The result of this rising is that the upper portion of the milk becomes richer than the original milk in fats, while the lower portion becomes poorer. This upper and richer portion of the milk is called **Cream**, and the lower and poorer portion is called **Skim-Milk**.

The fat globules in milk, while free to move about in the milk, are not absolutely separate from other constituent parts of the milk. Some of the **Caseine**, or "cheesy" portion of the milk, adheres to the fat globules with more or less tenacity. The adhering substance being heavier than the globules, it weighs down the latter in some degree, impedes them in their upward movement, and, along with the milk, makes up the bulk of cream.

Skimming, or Creaming. The process of separating cream from milk was originally called skimming, because that word indicated the only mode of separation once known. Now there are various methods of milk separation, and the word "creaming" more properly expresses the process.

The main object in setting milk is to obtain from it as much as possible of the cream. The second object is to secure the skim-milk fresh and sweet, in good condition for use in feeding, etc. There are distinct systems of creaming milk, the first of which is the natural, or **Milk-Setting** system.

A Thermometer begins now to be a dairy necessity. Temperature is one of the most important factors in scientific butter-making, and the thermometer is the instrument by which temperature is determined. The sense of feeling cannot be depended upon to tell the temperature accurately for dairy purposes, any more than one's inner consciousness may be depended upon to tell the hour of day or night. There should be a thermometer in the dairy of everyone in whose house there is a clock. The writer has been accustomed to represent the thermometer as the key to scientific butter-making—it being a symbol of definite rules of working.

The thermometer is a very simple instrument, which everybody can use without need of practice. Insert the bulb (or bottom part) into any substance, and hold it there until the column of liquid (usually mercury, and to be seen in the small tube) has come to a perfect rest. The point at the *end of the column* will indicate the temperature, in what are called *degrees*. In most thermometers the degrees are not all marked by the corresponding figures; every ten degrees only are so marked. One may read the intermediate degrees by the short ladder-lines between the figures, each ladder-line usually marking two degrees. Degrees are usually represented by the sign (°); as 60°, 90°.

The degrees are marked from zero (0°) upwards and downwards, respectively expressed by the words "above zero" and "below zero." When any number of degrees is given without any defining words, it is understood to be degrees *above zero*. For instance, cooling to 30° means cooling to 30° above zero. Below zero is always defined: as 20° below zero. Sometimes the plus and minus signs are used, as for instance: +50°, meaning 50° above zero; and −10°, meaning 10° below zero.

CREAM Rising—The Theory of. The Movement of Fat Globules, when single, towards the surface, is extremely slow. The reason of this is, first, the **Extreme Minuteness** of the globules. It would require from one thousand to five thousand of the larger ones, ranged alongside each other, to make a line of them one inch long! Some of them are so small that it would require ten times as many to do this! Fleischman estimates that a single pint of milk would contain *forty-five thousand million globules*.

Their slow movement is due, in the second place, to an **Adhesion of Caseine**, which, being heavier than the globules, burdens them. The movement of the globules, however, is more slow at the beginning than later. Some of the globules, which are larger than others, and more free from caseous encumbrance, move the fastest, and it happens that such single globules overtake other globules, and when these join, the movement is further accelerated. These combinations continue to grow, in size, as they move upwards, and to increase in speed. In time the movement of single and separate globules which was at first so slow as not to be observable, becomes the movement, as it were, of clusters, or *flakes*, with a speed visible to the naked eye! The writer has observed this movement, in milk set two feet deep, when it had attained a speed of not less than one inch per minute! The appearance of these cream-flakes was like that of a snow storm, with the snow-flakes all moving upward, instead of falling.

What has just been described seems to the writer to be one of the first principles in the philosophy of cream-rising, and the very basis of the natural system of milk-setting. Moreover, it seems to be the main explanation of the phenomena of the rising of cream through a considerable depth of milk, almost or quite as well as through a shallow body of milk. It seems to matter little if milk be set two inches or two feet (except in the effect of depth upon the changes in milk, through retention of warmth, æration, &c.) The explanation is found in the principle just given. In rising through a space of say two inches, there is little accumulation of globules, and their movement is slow; but through a space of say two feet comparatively large flakes accumulate, and these carry up, in their progress, many globules which otherwise would not have reached the surface, even if set shallow. Depth is discussed here in reference only to *movement of globules*, and not in reference to changes in milk, convenience, etc.

The Fact of Currents is the second principle in cream-rising. There can be no movement in liquids in one direction without a corresponding movement in another direction. The upward currents formed by the rising of cream globules, or cream-flakes, necessarily causes downward currents of milk. The globules which are the lightest and freest and have the strongest upward tendency, are the ones first to move upwards. The globules which, because of small size and a caseous burden, possess the least tendency to force themselves upwards, are likely to be *carried downwards* in the downward currents. The turn for some of the inferior globules comes when the strongest movements have subsided, while less favored globules are carried so far down that they do not reach the surface at all. This being true, there will always be more or less of fat in all skim-milk. It will follow, too, that the skim-milk at the bottom will be poorest, and that near the cream line the richest. This theory of currents explains the known fact that the cream which first rises is composed of globules which are largest, and so make the finest butter.

The third principle in the rising of cream is the **Changes Constantly going on in Milk.** Milk is subject to constant change, from the time it is first formed in the milk glands till it has ceased to be milk. Milk is at its best at the very beginning of its life, and from that time on it deteriorates. These changes are unfavorable to the rising of the cream. Cream will rise best when the least change has taken place in the milk. Now, for all the cream to rise in milk, considerable time is required, because of the *slow movement of the globules*, and the *counter action of currents*, as already described. The changes going on in milk so shortens the time that the cream *cannot all rise* in the time available. How much of the cream will rise, therefore, depends, among other things, upon the *condition of the milk* in respect of the changes to which it is subject. The writer believes this principle to be the one first of all in practical importance in milk setting. Doubtless, mainly to this fact of *changes in milk* is owing the *variation in quantity of cream* from *like qualities of milk*, at different times and under different conditions of atmosphere, temperature, etc.

The fourth and last principle in the theory of cream-rising is that of the influence of **Temperature.** The first influence of temperature is an indirect one, or the effect which temperature has upon the changes in milk. Milk at its normal temperature when newly-drawn, will undergo rapid change, which change is more slow as the temperature is lowered, and arrested as the temperature approaches freezing point.

There is nothing in dairy literature on milk-setting to-day that has a wider currency than the theory of a **Falling Temperature.** This theory owed its origin to one who deservedly stands at the head among workers in dairy lines—one of the pioneers in dairy science, the venerable, genial and modest Professor Arnold, whom all delight to honor.

The theory of a falling temperature having a direct effect upon the rising of the cream is explained by the fact that water, of which milk is largely composed, is a better conductor of heat than is fat, of which the cream globule is mainly composed. When milk is cooling, the watery part is affected before the cream, and therefore is the first to contract. The cream, because of this more speedy contraction, becomes relatively lighter, and its upward movement is accelerated.

Whatever there may or may not be in the theory, there is no doubt about the need in dairy practice for immediate and rapid cooling of milk, and in that cooling it will necessarily get the benefit of a falling temperature. How rapidly milk should be cooled down certainly will depend something upon its condition, or the rapidity of changes going on in it. How much it will depend upon the direct influence of a falling temperature the writer is unable to say.

A High Temperature. There is reason to believe that a high temperature is more favorable than a low one to the rising of cream. Milk becomes more fluid-like as it gets warmer, and more viscous as it gets cold. Cream appears to move upwards more freely, meeting with less resistance, when the milk is warm and rarefied, and to move with greater difficulty when the milk is cold and sluggish. There may be other reasons, but the strongest one is that found in practice. In the use of the centrifugal machine, the cream will not separate so readily when the milk is cold as when warm. It is usual to heat the milk to nearly 90° before skimming. The machine is supposed to separate 150 lbs. of warm milk to 100 lbs. of cold milk. It is probable, therefore, that the higher the temperature, other things being equal, the more rapidly cream will rise. This would lead to keeping milk warm, were it not that the warm milk changes too rapidly. It suggests, however, *utilizing the time milk is cooling* to get the benefit of a *high temperature*.

It is because of some such reasons as these here set forth, in the above theories, that cream acts so differently at different times—it being due to the varying conditions that result from weather, conditions of cows, etc., etc.

A few simple **Experiments** would indicate the basis of some of the previous conclusions. Let it be supposed that the reader has a tin vessel three feet long and three inches in diameter. There are in it two glass windows, about 10 inches long and one half wide, one at the bottom and one near the top. At the bottom there is a faucet, or well-fitted plug. This vessel is filled with milk and the following phenomena is observed: First, considerable time—perhaps an hour—will elapse before any cream will show itself at the top. When, however, the cream once begins to gather, it accumulates very rapidly, perhaps one-fourth of an inch in ten minutes. By and by it will appear to have ceased to accumulate; and the quantity of cream will appear even to become less! Again, after the cream has begun to rise rapidly, the observer may stand before the vessel, facing the glass, and incline the top of the vessel towards him. A careful observation will show to the naked eye a miniature snow-storm of cream-flakes, but rising instead of falling. These cream-flakes will be seen through the top glass, rather than through the lower one. Now, if the observer will wait till the body of cream appears to increase no longer, but rather is diminishing in bulk, and will take a second observation, he will notice that the cream-flakes are moving up as before, and in apparently large quantities. These simple observations will sustain, so far as they go, the theory of cream-rising, as just explained.

Conditions Favorable for Cream-Rising. The first and most important condition is the **Creaming Quality** of the milk itself. More depends upon this than upon the system of creaming employed. The cream of one sample of milk, because of the creaming quality of that milk, will rise quickly and well, under otherwise unfavorable conditions. The cream of another sample of milk will rise slowly and incompletely, under the most favorable conditions of setting. This creaming quality of milk is dependent first upon the animal itself–its physical organization. This is not under the immediate control of the dairymen and will be more properly treated of in connection with the breeding and selection of animals. The creaming quality of milk is dependent also upon the *management of the cow*, and in this respect is under daily control. The quality of milk from the same cow, at different times and under different conditions, is exceedingly variable. It is affected by such conditions as distance from calving, the treatment of the cow, the distance or length of time between milkings, also the food and drink. The writer believes this to be more important than any other factor in cream-rising, except it be the rapid cooling down of the milk. If one would be successful in separating the cream from the milk, let him attach much importance to the *condition of the milk when it is drawn from the udder.* Let him first see that the milk be pure at the very beginning, that it be the product of wholesome food, consumed by healthy cows kept in well-ventilated quarters. Let the time between milking never be more than twelve hours, and let the milk be drawn into clean vessels. If the best that is possible has been done in these respects, and the milk be speedily removed from the milking-place to a pure atmosphere, and there immediately set for rapid cooling, good results will be obtained, whatever the system of milk-setting one may employ.

The second favorable condition is that where there is **No Delay in Setting**. This is a very important condition, and obtains under any system employed. As soon as the milk has been drawn it should be set. Unnecessary loss here is sheer wastefulness. The little life of milk at its best is all too short for cream-rising. Some of the cream, in any case, will be left in the milk. The quicker the milk is set the less will be that residue.

But this mere loss of time is the least evil of the delay. If that loss were at the end instead of at the beginning it would not be very serious. When milk is first drawn it is, by virtue of its temperature, in its most critical condition for keeping, and, by virtue of its freshness and a high temperature, at its best for giving up its cream. To get good results it is necessary to quickly relieve that critical condition by lowering the temperature, and to take immediate advantage of the momentary favorable conditions for cream-rising by giving the cream a chance to rise during the process of cooling. Prof. Henry, of Wisconsin, found this loss to range from four to nine per cent., from a delay of from twenty to thirty minutes. Such loss may be sometimes greater, sometimes less. It might be partially—not wholly—made up by lengthened setting, but other considerations usually forbid this.

This condition being a simple one and under easy control, the very least that any dairyman can ask of himself is to see that there be *no time lost* in setting the milk, so that while it will be cooling down from its riskful temperature the cream will be making good its short-lived opportunity for rising.

The third favorable condition is that of **Perfect Rest**. Agitation of milk or cream in churning serves a useful purpose. In this case the cream globules have aggregated and the cohesion of the caseous attachment is weakened. But in cream-rising the minute globules are single and far apart, their caseous attachment is fresh and strong, and agitation serves only to hinder the process. The force of the upward movement of cream globules is so slight that it cannot resist any appreciable counteracting disturbance.

Other favorable conditions are those which will **Arrest the Changes in Milk**. The cause of changes in milk are the presence of seeds, or germs, which grow and multiply, and hasten the souring, or decomposition of milk. If new milk be heated to a temperature high enough to kill these germs, and sealed from the atmosphere, it will keep sweet indefinitely. If it be so heated and then exposed to the air, it will *keep sweet longer* than will that which has not been so heated, but it will sour after a time. But if average new milk be sealed from the atmosphere without having been heated, it will go soon to decay. From all this it would appear that the seeds of decomposition of milk are both in the milk itself and in the atmosphere to which milk is exposed. Now, the creaming of the milk demands that the action be arrested of these germs which cause the souring of the milk, thus checking the upward movement of the cream.

The agencies which will check such action are important to the dairyman. The first is **Aeration**. Aeration, as understood in dairy work, is simply exposure to the air. It has two objects. The odors and germs in milk, which multiply and hasten decomposition, are dissipated or destroyed by the action of the oxygen of the air. This service of the atmosphere is a most valuable one. The second object of aerating milk is to advance that process in the cream known as "ripening," to which reference will be made later. This second object in milk-setting is incidental.

Aeration of milk for milk-setting, demands two conditions, first that the *milk be warmer* than the surrounding air, and second that the air itself be purer than the milk.

Milk may be aerated before setting, or it may be set to aerate itself. In the first case it is usually done by ladling it, or by pouring from one vessel to another, in the pure open air and while it is still warm. In the second case it is done by setting in shallow vessels and exposing as large a surface as convenient to the air.

Whether it will be profitable to take the trouble to aerate milk before setting, will depend upon various conditions—the condition of the milk, the system of setting and the labor involved. If the milk be set shallow, without loss of time, in a pure atmosphere, no other aeration is required. The large surface exposed to the air in shallow-setting provides for aeration. The same may be said of milk that is in *good condition when drawn from the cow*, and set at once in deep cans, to *be cooled down rapidly.*

The time when aeration is specially advantageous is when milk is *defective at the start*, as, for instance, in the heated days of summer, or when it has to be cooled down for transportation, in closed cans. Care should be taken to aerate the milk while it is still warm.

The time when aeration is to be avoided is when the milk is colder than the atmosphere, or when the atmosphere is at all impure. Aeration when employed must be carried on quickly, otherwise the loss of time before setting will offset partially the advantages.

There is no question as to the advantage of aeration and cooling of milk intended for transportation to any distance from the farm; but there is some question as to the advantage of aerating milk in ordinary butter-making. In some experiments made by the writer the aeration of milk seemed not to be advantageous; whether due to the agitation or to something else it is yet difficult to say. All things considered, one of which is the labor and delay involved, it is doubtless better to set milk at once, for cream-rising, at least if the milk itself be in good condition. Whether agitation would be advantageous under the peculiar conditions of imperfect milk, it will be better for each one interested to determine, according to the special circumstances of the case.

The second agency for arresting the action of germs in milk is **Cooling**. Moderate warmth, or the temperature of new milk (98°), and in a decreasing degree downwards, is most favorable for the growth of milk germs. Cold, while it does not kill these germs, renders them inert, and checks their action. When the temperature has been reduced to 50°, and lower, the action of these germs is greatly arrested. Cooling accomplishes still more than this, for the heat which passes off *from the surface* of the milk, carries with it odors of the milk which themselves, being ferments, are active agents of decay.

Another agency is **Heating**. The germs in milk grow most rapidly at blood heat, or the heat of new-milk; but higher temperatures are increasingly unfavorable to them. There is probably no temperature short of boiling that will kill all milk germs, but there will be a slaughter of them at all temperatures from say 105° upwards.

Take a small quantity of milk, mix it well, and divide it into three portions. Heat one sample to 140°, another to 120°, and set these alongside the other sample that has not been heated. It will usually be found that the sample which was not heated will be the first to sour, the one heated to 120° will sour next, and that heated to 140° will be the last of all to sour—souring perhaps 24 hours after the first sample has soured.

It will be found, too, that objectionable odors have been dissipated from the sample heated to 140°, and that the milk has been improved for use. The advantages of heating milk are the destruction of milk germs and the purifying of the milk.

Heating

Another advantage was once supposed to belong to heating, namely, that of affording a greater range of falling temperature, which was to be secured by the after-cooling. The writer does not strongly urge this advantage. Some recent experiments by Professor Henry, of Wisconsin, indicated an actual loss by heating up to 110° and 120°. How much of that loss was due to the loss of time in heating, or to a delay in setting, it is difficult to say. Although the writer has experimented not a little with a view to discovering the influence of all the agencies affecting cream-rising, he has not been able to satisfy himself so perfectly as to be willing to risk any positive statement here; but at least he does not advise heating for the sake of advantage that may be expected from the after-cooling.

The effect, too, upon cream, and butter and cheese, of heating milk, is one to be carefully considered. It has been claimed that by heating milk, butter is improved in flavor, and that the cream will churn more readily; and, further, that the butter will have an excellent flavor, and the cheese will be delicious and pure-flavored, *even though the milk be tainted.* The writer will leave these opinions as they are, and suggest that whether or not there be improvement of milk by heating, depends upon the condition of the milk. The question arises whether the keeping quality of the butter may not be injured by the heating of milk.

There are, however, a few points in heating milk which may be depended upon. The first is the PURIFYING EFFECT upon milk, already explained, which shows that there *may be times* when it will be an advantage to heat milk, and those times are when milk is defective, or tainted, or when it is necessary to prepare milk for long keeping, and especially for transportation.

The second point is that milk when *new* should *not be heated up to 150°, or "scalding."* Many excellent authors, and much current writing, advise the *scalding of new milk!* Be assured that under some conditions, at least, such scalding will result in a marked *loss of butter.* This statement has reference to the scalding of *new* milk, not the scalding of milk that has set for twelve hours, and upon which a cream has already risen—the Devonshire practice. Most if not all of the advantages of heating new milk will be secured by heating *not above 140°*, and without that loss that will result from heating to 150° or above.

falling

The third point settled is that there is considerable *labor involved* in heating milk, which makes it less an object to heat it. All things considered, it is not desirable to heat milk except under peculiar conditions, or in cases where the advantages are marked and undoubted; and the heating then should usually be not higher than 140°. If it be required to heat milk simply to get advantage of a falling temperature, it is doubtless sufficient to heat only to 104°.

The Manner of Heating Milk. If fire be applied directly to the milk, it is likely to scald or burn the milk. To avoid this, the heat should pass through water. The milk-vessel may be conveniently set in a larger vessel, and the latter placed directly over the fire. The bottom of the milk-vessel even should not rest flatly upon the bottom of the water-vessel, it being necessary for the water to stand between the milk-vessel and the bottom of the water-vessel which has immediate contact with the fire.

There are **Two Systems of Milk-Setting**. The oldest system is that of **Shallow-Setting**, and the newer one is known as **Deep-Setting**. In the former method the milk is set at a depth of from 2 to 5 inches, in pans, usually in air, and in the second case in water or ice, at a depth of from 14 to 20 inches, in pails or cans. These cans are commonly called **Creamers**.

There are manifest advantages in the newer system. Fewer vessels and less space are required, and the labor of caring for the milk is reduced, the skim-milk is more easily kept sweet, and so is more valuable for feeding. Deep-setting is somewhat more independent of dairy conditions, and of the changes in temperature.

Yet there are some conditions necessary to deep-setting, the principal one being an abundance of water, either very cold, or with ice, and conveniences for its use. On the whole, the deep-setting system is the one to be preferred in most cases; although the writer has known of a number of instances where this newer system has been given up and a return made to the old one. The Hon. Harris Lewis, one of the most successful of the American butter-makers, and an acknowledged authority, says he has tried all the methods except the centrifugal, and he has chosen the large shallow pan, keeping the milk at about 60° There are many advocates, however, of the deep-setting, which is not losing favor. The circumstances of each dairyman must determine the preference for either system.

The first requisite in either system is a **Pure Atmosphere.** When the milk is first set, and is much warmer than the surrounding air, it will give off its heat and will be less liable to take in impurities; but as it cools down to its surroundings, it will begin to take in everything objectionable that the air contains,—decaying milk or vegetables, the scent of kerosene, tobacco, odors from the barn, etc. The milk set deep and cooled by water below the temperature of the air, will take in odors and impurities much more readily than that which is no colder than the air.

Time of Setting. Milk set in shallow pans is usually allowed to set longer than in deep cans, but there is little doubt that one of the principal faults of old-time butter-making was that of allowing milk to set till the cream was injured for butter, and the skim-milk for feeding The gain in quantity of butter was much less than was supposed, and that gain was twice offset: first by loss in quality of butter, and again by quality of skim-milk! In any system of milk-setting the bulk of the cream, and the best quality of cream, rises within twelve hours, the bulk of the balance in the next twelve hours, and what will not rise in the third twelve hours is worth waiting for only when it is secured before the souring of cream or milk.

To the general rule, however, that the bulk of cream will rise in twelve hours, exception must be made. The milk of some cows has poor *creaming quality.* The cream from such cows is slow to rise and may be set longer, to advantage; but *butter-makers* will find such cows good ones to get rid of to *cheese-makers.* While one has such cows in possession, however, rather than wait till milk sours for the cream to rise, it would be better to cream earlier, and take up a larger proportion of the (top) milk.

In deep-setting the time may be twenty-four, or thirty-six hours, according to circumstances, such as the creaming quality of the milk, the facilities for keeping milk sweet, and the convenience, such as available stock of creamers, &c., &c.

It has been frequently claimed that "All the cream will rise in twelve hours." This claim forgets that in no case does milk throw up *all* its cream, that the cream of the milk of some cows rises more quickly than that of others, and that the rising of the cream depends upon the condition in which the milk is, the temperature at which the milk is set, etc. There have been instances in experimental work of a very close creaming in eleven hours, but not every dairyman has such cows, and creaming facilities, as in the instances referred to.

Cooling Milk. When milk is set in shallow pans in a cool room, the cooling of the milk, along with the aeration, is sufficiently rapid to arrest the changes in the milk and enable the cream to rise. The room should never be above 60°. This will be a good temperature if the condition of the milk be good and the atmosphere pure; otherwise the temperature should be even lower. Milk set in deep cans, having larger bulk, will of course cool more slowly than when set shallow, and some provision must be made for more rapid cooling.

This is accomplished by the use of a better cooling agency than air, viz., **Water, or Ice.** Where ice is not employed, the water should be as cold as it can be supplied, and abundant. The more defective the milk when set, the more the need of rapid cooling, and the colder therefore the water should be.

The difficulty experienced by farmers who have not ice, is the fact that the water is warmest at the season when the condition of the milk demands that it be coldest; as in the hot months of July and August. It is at this time that ice becomes of most value.

Where ice cannot be had, however, especial care will be required at this season, in order to secure the cream without considerable loss. It would be an advantage, where the water available is not so cold as it should be, to have milk-cans of smaller diameter, say 6 inches instead of the ordinary size, 8 inches.

It is a great advantage to have running water, or water in sufficient abundance to be changed frequently. Where water is running, and the quantity can be regulated, it should be allowed to run a liberal stream at the very beginning, and, if economy demands it, the stream may be slackened later, after the milk has cooled down to a safe degree.

Where dependence is placed upon changing the water, it should be done in a comparatively short time after the milk has been set; for it will be noticed that the heat of the milk passes very rapidly into the water at the beginning, warming the water and so reducing its cooling effect.

In the use of ice for cooling milk, if ice be plentiful, it may be broken very fine, when it will cool the milk more rapidly; but if it be necessary to economise the ice, it may be broken only into large-sized lumps, thus requiring less ice, but not cooling the milk so rapidly, nor so low.

Application of Theory. The writer is deeply conscious of the difficulty of giving directions for creaming milk that will serve the purpose of all circumstances, times and places. Milk is extremely variable in its character, being affected by so many conditions: such as breed and individuality of the animal. The milk from the same cow undergoes constant change from time of calving until drying up, and it is also quickly affected by changes in feed, in weather, in treatment, etc.

All this has made investigation very difficult, and has resulted in slow advance in knowledge concerning milk action. This variation is enough to at once account for the fact of the existence of many erroneous opinions and wrong theories regarding milk-setting, and the impossibility, sometimes, at least at the present stage of knowledge, of giving explicit directions that will suit all occasions.

By way of illustration: Prof. Fjord, of Denmark, found in re-heating, to 104°, milk that had been cooled and transported before setting, a *gain* of from 6 to 30 per cent. On the other hand, Prof. Henry, of Wisconsin, found in re-heating, to 110° and 120°, milk that had stood before setting twenty to thirty minutes, and had cooled to 82° to 93°, a loss of from 4 to 12 per cent! Such results as these do not much help to explain the actual effects of heating milk, but help rather, only to open up a wide field for one to experiment further for himself.

Similar reported experiments giving contradictory results might be quoted, bearing upon nearly all the questions in dairy practice with which the author has to deal. The following is interesting, showing, as it does, how completely at variance two authorities may be; the disagreement being in this case upon the question of the *time* which will be required, at different temperatures, for the cream to rise. No. 1 authority is Johnstone's chemistry; No. 2 is Tisserand, a French author, quoted by Mr. Long:—

TEMPERATURE.	35°	42°	50°	55°	60°	68°
No. 1 says Milk "Will cream perfectly" in......................	(not in)3 weeks	......	36 hrs.	24 hrs.	......	20 hrs.
No. 2 says "The whole of the cream will rise" in....................	12 hrs.	24 hrs.	......	......	36 hrs.	......

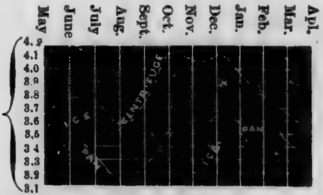
Notice that the two statements are diametrically opposed, thus:—

No. 1—Hours: 36—24—20.
No. 2— „ 12—24—36.

The temperature at which authority No. 1 claims that milk will not give up a notable quantity of cream in *three weeks*, is the same temperature given by authority No. 1 as the temperature at which the cream will rise in *twelve hours!*

Even from careful and painstaking experimental work erroneous conclusions may be drawn. For example, given the enquiry which of two systems will give the best results, and a resort to experimental work for the answer. The answer may depend not only upon the respective systems, but upon the *condition of the milk* and the *season of the year!* If the question be whether the deep-setting or shallow pan be best, the answer in July, August and September may be in favor of deep-setting, whilst in November and December it would perhaps be in favor of the shallow pan. Such have been the actual results of experimental work by Prof. Fjord, which are shown in the diagram here presented and which serves to show clearly the erratic tendencies of milk:—

Number pounds Butter from 100 pounds Milk...........



The figures on the left show the *butter values* in the results, or the *number of pounds of butter per hundred pounds of milk;* and the results are given for a *full year.* The horizontal lines correspond with the butter values; and the perpendicular lines with the months of the year. For instance, the shallow pan was at its best in December, when one hundred pounds of milk gave a little more than three and six-tenths (3.6) pounds of butter.

It will be seen that the "centrifuge" is generally highest, but is beaten by the deep-setting, or ice, system in August, which month is hard both upon the centrifuge and shallow pan. In November the ice is at its lowest, and is then beaten by both the pan and centrifuge, which are equally at their best. It will be noticed, too, that the ice system runs counter to both the other systems, while the latter seems to move in sympathy.

This peculiar movement is not inconsistent with the theory of cream-rising explained in this Manual. The centrifuge and the pan are both dealing with milk which is at *higher temperatures*, and cooling less rapidly than milk in the ice system. It were as if the higher-temperature advantage in the case of the centrifuge and pan, in August, were offset by the quick changes in the milk; and that the too rapid cooling by the ice system in November caused the loss of the advantage of a high temperature in overcoming "heaviness" in the milk, which advantage was realized at its best by centrifuge and pan.

This, however, must not be accepted as conclusive, but rather as suggestive. What is being given here is not so much to sustain theories as to show the difficulties in the way of theorizing, to warn against placing too much dependence upon theory, and to lead up to the suggestion of something better than theory, or a way by which the dairyman may partially *guide himself* in his search for the *most profitable system* for his *own circumstances*.

This suggestion is a proposed way by which the farmer may do **Profitable Experimental Work** for himself, or make trials for himself to obtain the best of all evidence—actual results. There is a little instrument called a **Lactometer**, the use of which is easily learned, and which would enable any experimenter to make all the trials necessary to satisfy himself as to the comparative merit of any system of milk-setting he may choose to test.

The lactometer is an instrument which tells the specific gravity, or weight, of liquids. It is inserted in the liquid, allowed to sink slowly until it comes to a perfect rest, when the specific gravity of the liquid is indicated by the figures on the stem of the lactometer, at the point of the *surface of the liquid*.

The value of the lactometer for dairy purposes comes from the fact that the constituent parts of milk possess different specific gravities, and the presence or absence of one or other may in some cases be detected by this instrument.

The fat is the lightest of all the constituents of the milk. The removal of cream from milk leaves the milk heavier; and the *more of the cream is removed the heavier the skim-milk*. The lactometer registers very accurately this variation in the weight due to removal of cream.

It is in these facts that we have conditions for making a comparison between different systems of setting milk, by learning which system removes the most cream.

The manner of conducting the test is as follows: The sample of milk that is to be set is first sufficiently stirred or shaken to be *thoroughly mixed*. A record is then made of its specific gravity. Separate the milk into as many lots as there are trials to be made, having a care that each lot of milk be maintained of the same quality, by constant stirring. When the milk has been creamed, make a record of the specific gravity of the *skim-milk* of *each lot*.

Every lot of milk was of equal value at the beginning, due to its thorough mixing; so if now one sample has thrown up more cream than another the fact will be proved by the lactometer, by the milk being shown to be *heavier than the other*. If the specific gravity of the new milk be subtracted from that of the different lots of skim-milk, the one showing the largest remainder will be the one which has thrown up the most cream.

One precaution is necessary in the use of the lactometer. The specific gravity of liquids varies at different temperatures. A specific measure of milk—say one quart—will weigh more at 45 degrees than at 75 degrees. This difference will be shown, of course, by the lactometer; and it introduces an element of error to be guarded against. To provide against such possible error, it becomes necessary to reduce to the same temperature the samples of milk to be tested with the lactometer.

Most lactometers are graduated for use at a certain temperature—sometimes at 60°, and sometimes at 80°. For the purpose of such test as above explained it does not matter what temperature be chosen, so long as all the different samples of the test be brought to that temperature. But should a record be made of the test for purposes of making comparison later, with other like tests, it would be necessary to adopt a *standard temperature*, which preferably would be the one for which the lactometer now in use has been graduated.

It is not necessary to bring the whole lot of milk to the standard temperature. An average sample, of sufficient quantity to use the lactometer, is taken, is brought to the right temperature, and its gravity noted.

(A Table has been constructed which brings the specific gravity of milk of any temperature to that of a standard temperature. The use of this table makes it unnecessary to change the temperature of the milk in order to determine its specific gravity.)

The use of the lactometer here proposed is strongly urged upon the reader. It will be found more simple than the description would make it seem to be. It has several advantages over the churning of the milk.

First, it is simpler and saves labor. To test the creaming of milk by churning, not only involves the labor of churning, but of weighing carefully the quantity both of the milk and the butter. *Second*, it is more occurate. In churning there is the element of possible error both in the weighings of the milk and butter, and in the process of churning. Two quantities of cream of absolutely the same butter value will seldom, if ever, churn the same quantity of butter. Much more practice is required to enable one to do careful test-churning than to use the lactometer, and even after full practice there will always remain, doubtless, a larger limit of error in churning than that in the use of the lactometer. The reader is cautioned, however, against the use of a cheap and unreliable instrument.

Many questions will present themselves to the intelligent and progressive dairyman which no theories or practical instruments will completely answer. He cannot be told, for instance, which will always be the better system, the shallow or the deep-setting system. He will in some cases find one better and in other cases the reverse. He may be told provisionally that when he has a good dairy (pure atmosphere) and no cold water the shallow pan will be excellent, and perhaps the better system. And under the most favorable conditions for either system, neither will always be better than the other. Hence the advantage of making trials for himself, by the help of the lactometer, as explained. Hence the need of making tests of each system at different seasons, which can be done so quickly and effectively by simply taking the specific gravity of the skim-milk, provided the precaution has been taken to thoroughly mix the new milk, and set some of it by each system on trial.

Removing Cream, in other words **Creaming**, or **Skimming**. It was once thought necessary to use a "skimmer" or a sort of seive-scoop, with which to lift the cream. It was then believed that much milk in the cream was objectionable. This belief grew out of the old-time practice of keeping cream before churning it until it was downright sour. At this time, the old rule for creaming was to "Skim when the cream was so thick that it would not flow back behind the finger, as the finger passed through it." This rule was a natural outcome of the system once employed, but it was an unscientific rule. The condition of the cream was due to the temperature, moisture, &c., rather than an indication that the cream had all risen. Now that it is known not to be necessary to keep both milk and cream till quite sour, there is less need of leaving the cream on the milk till it forms a tough blanket that can be lifted. When lifting the cream with an old-time skimmer there is a certain loss of the undercream which runs through the seive back into the pan. Now that there is no objection to some of the milk being taken up along with the cream, it is better to discard the old skimmer, and to use a scoop without holes. With this the cream may be dished up with less loss, taking with it, of course, a small portion of the milk.

The old rule being discarded, a new one is in order, and the writer suggests the following: **Cream the Milk Before It Is Sour.** If the milk be in good condition, and it be kept in a pure atmosphere, at 60° or lower, it may profitably be creamed in 24 hours. If the conditions are not so favorable, it may be necessary to set it longer, but the need for setting it longer than 36 hours ought to be avoided.

Creaming

In Deep-Setting there are various methods of creaming. In the simplest form of "creamer," the cream is dipped up from the top. This method has to recommend it, its simplicity, its cheapness, while it secures the cream free from sediment—a very important consideration. Creaming in this way involves a little more labor, also some little care and skill to avoid the loss from mixing the cream with the milk; but with a little practice it can be done easily.

There is no objection to taking up some of the milk along with the cream, but one should have a care to dish up only the milk which is immediately under the cream, and which is the richest.

In deep-setting, the creaming dippers should be deeper, and provided with a longer and vertical handle.

How Low to Cool. There are two facts to be taken into account in connection with the cooling of milk. *First*, the greater the bulk of milk the less proportionate surface exposed to the air, or cooling influence, and, consequently, the more slowly will the milk cool.

Second, the cooling is more rapid when the cooling medium is a good, than when it is a poor conductor of heat. Milk will cool more rapidly surrounded by cold water than when surrounded by cold air.

Third, the greater the difference between the temperature of the milk and that of the cooling medium, the more rapid the cooling. To illustrate this. Dip a thermometer say in either warm or cold water and notice how rapidly the mercury will move while the range between the two points is greatest, and how slowly it will move when the mercury is near the point at which it will come to a perfect rest.

Wishing to cool the milk very rapidly, we may take advantage of these natural laws. In deep-setting the bulk of milk is very considerable, compared to what it is in shallow-setting. We can reduce this bulk, as much as we will, by making the milk-cans of *smaller diameter*. Then, water being a better conductor than air, we may use water, with or without ice. Thirdly, to obtain as long as possible a range of temperature between the milk and the cooling medium, we use water as cold as it is available. When using standing water, we find that the heat of the milk varies the temperature of the water and depreciates its cooling effect. To avoid this difficulty we have recourse, when possible, to running water, which being constantly renewed, is always at the low temperature required. If running water be not available we perhaps have recourse to ice, which keeps down the temperature.

As to the practical effect of a low temperature of the cooling medium, inducing rapid cooling, the following results of experiments made in 1876, by a French agriculturist, M. Tisserand, are of interest. The different samples of milk were set surrounded by water of different degrees of temperature.

To make one pound of butter;

Cooling medium at	36°,	required	21 to 22	lbs milk	Cooling medium at	52°,	required	27 to 28	lbs milk
"	39°	"	23 to 24	"	"	57°	"	28 to 32	"
"	48°	"	25 to 26½	"	"	72°	"	34 to 36	"

This is an unmistakable showing in favor of a low-temperature medium.

M. Tisserand does not tell us at what season of the year the experiments were made. This is to be regretted, in view of the teaching of the diagram already shown.

The question arises, whether the effect is owing to the low temperature, *for its own sake*, or owing to the more *rapid cooling* caused by the lower temperature. We do know that deep-setting is most favorable at a season when the condition of the milk requires that it be rapidly cooled, as proved by the defective results at such seasons of the centrifuge and shallow pan; both of which have to do with milk at a high temperature. Again, deep-setting is less effective when the milk is heavy. These facts seem to indicate that the good results of low cooling are not due to anything else so much as to the rapid cooling. At all events, it is clear that—at least in the season of the year when milk at a high temperature is in a critical condition—the more rapid the cooling the better.

Low-Cooling—Effect on Quality. There are few points in butter-making that have evoked more discussion than that of moderate *vs.* low cooling, as affecting the quality of product. There is no space available here for a full discussion, and the writer will be content to leave aside the theories extant, and to touch upon those points upon which there can be no doubt, or to know which will be of service to the dairyman. There are many practical authorities who claim that a low temperature must needs be injurious to the butter, especially to keeping-quality and aroma, or flavor. On the other hand it is claimed by advocates of low cooling that the butter thus made has especially good keeping-quality, and that the aroma may be developed in that system as readily as in another. It is far enough to enter into the discusssion to say that butter of excellent keeping-quality and fine flavor has been made by both the deep-setting system and low-cooling and by the shallow system and a temperature not below 50°. It has been claimed too, that, the practice of low-cooling has been especially successful where butter has been made for export, and that a higher temperature has been most successful where butter has been sold for immediate use, almost or quite fresh. Here, again, the argument in either case is faulty, because all the factors are not considered, and the facts given us afford no principles upon which to base conclusions. The truth is, in making butter by the different systems, different treatment of the milk and cream is demanded; while intelligence and skill will tell for good under either system.

THE Centrifugal System. This system of creaming milk may be designated the **Mechanical Method.** It is of recent introduction. Centrifugal force is a force of nature, by which bodies made to move in a curve tend continually to fly off from the axis of their motion. A body set in motion tends to move in a straight line, and will so move unless forced by a counter influence to deviate therefrom.

If a vessel containing a liquid body be made to revolve, the liquid will be forced by its confines to revolve about a central point; but it will *tend continually to break away from that centre.*

Another fact is that the greater the specific gravity (or weight, compared with weight of an equal bulk of water) of a body subject to centrifugal force the more easily the body overcomes resistance, and the tendency to fly from off the axis of its motion. If a liquid body which is caused to revolve in a vessel be composed of elements of different specific gravities, the heaviest of these will force themselves to the outer diameter of the liquid body, or to the walls of the vessel, leaving the lightest elements at the central point of the motion, and the medium weights between the two extremes.

Another law is centrifugal motion is that the greater the speed of revolution the stronger the outward tendency, or force. Of course the farther from the centre the greater the speed.

These are natural laws that have been long known. The effect of the working of these laws is called *centrifugal force.*

This force had already been applied to other purposes, but it was only as late as 1876 that it was applied to the creaming of milk. The application of this force was made possible by the fact of a difference in the specific gravity of the different constituent parts of milk.

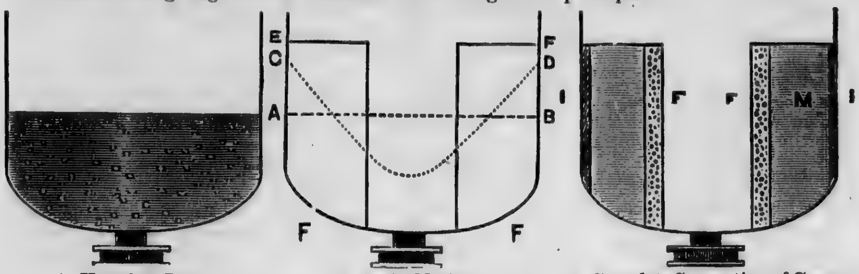
The sugar and caseine which milk contains in solution, are heavier than the fats which milk contains held in mechanical suspension. If then milk be placed in a vessel and the vessel be caused to revolve with speed, the heavier portion of the milk, or the skim-milk will be thrown towards the outer diameter of the vessel; and the fats, being lighter, will be forced to take a position nearer the central point.

The impurities which the milk contains or all the solid matter that is not in solution in the milk and which is heavier than the *serum*, or milk itself, will be thrown to the very outer edge of the circumference and will impart itself as an actual layer of dirt, against the walls of the machine.

Having secured the separation of the cream from the milk, some device is required for drawing off the cream and skim-milk, each into separate vessels, and a means of keeping up a continuous supply of new milk. This has been attained by a variety of machines which have been invented, and which machines are known as "**Centrifuges,**" or "**Cream-Separators.**" It seems at first something wonderful that a machine can take in new milk and turn out cream in one stream, and in another stream skim-milk. But the only thing about it that is wonderful is the ingenuity of man in utilizing *natural laws* to serve his purposes. The separation of the cream itself, under the actual conditions, is no more wonderful than the fact that cream separates itself, by rising, when the milk is standing still. The result in both cases is due to the fact of the difference in the specific gravity of the elements of which milk is composed. In the natural method of cream separation, the cream rises out of the milk, as it were, leaving the *milk* behind. In the artificial process, the milk being heavier than the cream, is thrown by the centrifugal force away from the cream, as it were, leaving the *cream* behind. In the natural process the separation, owing to the slight difference in gravity of cream and milk, is comparatively slow; in the artificial method the separation is quite rapid, owing the natural tendency of movement being increased by the centrifugal force.

Below we illustrate the principle upon which all centrifugal machines are constructed. The differences between the various machines are merely differences of detail. What is here given is common property, and not patentable. The several machines in the market are doubtless patented, at least in some countries; but the invention consists in some special features in the details of construction, of more or less merit. Such details have to do with the shape of the vessel, or bowl, with the application of the power, the devices for drawing off the cream and skim-milk continuously, and such like matters. With patented articles we have here nothing to do. Even if the writer believed one particular machine to be better than another, it would be inconsistent with the design and purpose of this manual to state his belief. The proprietors of all dairy instruments that are controlled by patents usually advertise fully and elaborately, and the reader who is in want of any special article is here advised to write to the different dealers or manufacturers for full particulars, and to visit, if possible, a dairy where each machine is in use.

The following diagrams will illustrate the working of this principle:—



1. Vessel at Rest. 2. Set in Motion. 3. Complete Separation of Cream.

MILK SUBJECTED TO CENTRIFUGAL FORCE.

In the vessels of milk, which are supposed to be circular, the skim-milk is represented by dashes and the fats by dots. In the first vessel, the milk is at rest and at a level, and the milk and fats (dashes and dots) are mixed. In the third vessel the milk has been subjected to a high speed of revolution, and the milk is no longer at a level, but forms a *perpendicular wall* around the sides of the vessel. One may look down into it and see the centre-bottom of the vessel! The vessel has been revolving for some little time, and the skim-milk and fat have separated. The skim-milk (M) forms the outer portion and the fat (F) the inner circle. It is as if the walls of the vessel had a thick coat of plaster and the surface of this coat a thin coat of putty.

In the second illustration one may see the course of the change in position of a liquid body subjected to centrifugal force. The space under the dotted lines A to B represents the liquid at rest. The space under C and D represents the position of the liquid body after having been for a time subjected to the force. The space under the dotted lines E and F represents the appearance of the liquid after a still longer period of revolution.

Anything in the milk not in solution, such as foreign matter, dirt, &c., or even in portion of the caseine, being heavier than the liquid, will be forced upon the walls of the vessel. This force tends to purify the milk. In the third vessel will be seen the manner in which impurities pack as a distinct layer (I) against the walls of the vessel.

Special advantages of the Centrifuge. The first advantage is the *increased yield of butter*. A glance at the diagram which appears on a previous page will show that the centrifugal machine is far superior to the other systems. It was only once beaten, during a whole year's experiments; and that in August, by the ice-system. In other instances the centrifuge has been superior to other systems at all times and seasons. There can be no reasonable doubt as to the effectiveness of the centrifuge in point of quantity of butter produced, and to its superiority in this respect over all other systems yet known.

The second advantage is the *speediness of the creaming*. Milk may be brought direct from the cows and turned into the machine; the creaming will begin almost immediately, and go on continuously, a single machine creaming the milk of a herd of perhaps 50 cows in one hour.

The third advantage is the *quality of the skim-milk*. Whether it be for feeding or skim-cheese making, the skim-milk from the separator is in excellent condition. Aside from the loss of its fat, the skim-milk has undergone no change to hurt it; indeed it is doubtless somewhat improved for some uses by having been purified by aeration and removal of sediment and dirt. It is, of course, somewhat poorer from the loss of so large a proportion of its fat.

A fourth advantage is in its use in factories. It will allow of the *transportation once daily* of milk to the factory; and possibly the carrying back of the skim-milk, by the farmers, on the return trip. There are other minor advantages.

Disadvantages of the Centrifuge.—The first disadvantage is the *higher cost* of the machines. The original cost of manufacturing these machines, royalty to patentees, and the commission on the sale of them, all combine to make them quite expensive. It places them out of the reach of many who might otherwise use them. The increased butter yield, however, will help to pay the cost; and it may be expected that improvements and competition will cheapen the machines not a little. The high cost of the separators is partially compensated for in a great saving otherwise.

The second disadvantage is the necessity for *power*. The power required—for the smaller ones at least—is not large; but, unlike the old system, the centrifuge cannot be run without some kind of motive power be supplied it—be it steam, water, or horse power. This adds to the cost of plant, and to the cost of running.

The third disadvantage is the *risk in using centrifuges*. The writer would guard the reader against any undue alarm when he does his whole duty by calling attention to the fact that accidents attended with fatalities have occurred in the use of the centrifuge. With almost all machinery accidents are possible; but generally, if not always, avoidable. The greater the risk in running machinery, the greater the need of intelligence, caution, and carefulness. There is no absolute need for accidents in running centrifugal machines. In buying, one must require of the manufacturers that the machine be perfect in construction, that a *capable machinist or mechanic be sent to put it up*, that he *stay long enough* to put the machine into *running order*, and to give *adequate instructions for its safe running*. Any serious accident that happens to a centrifuge comes of it being run at a speed *higher than its construction will admit*. There seems no reason why the centrifugal machine may not be tested, and then used within its strength, just as well as a locomotive and a bridge are tested.

The fourth disadvantage is the *limitation of its adaptation*. The centrifuge is almost or quite valueless except under suitable conditions. For instance, a very small dairy could neither afford the cost of the centrifugal outfit, nor afford to run the machine. The smallest machine made, up to a recent date, required at least thirty to forty cows to supply it profitably. This disadvantage may yet be removed. We may yet see a machine that will be easily propelled by some cheap and common power, say by dog power, that will profitably separate the cream from less than one hundred pounds of milk. Prof. Long, indeed, states that there is a machine in the market already that can be worked by hand power.

The question of quality—how the butter of the centrifugal system compares with that of the natural system, is open to some discussion. On the one hand, it is claimed that the centrifugal process gives the best quality of butter. Theoretically this claim seems a reasonable one. The purifying of the milk, and the freshness of the cream, would seem altogether in its favor.

Yet we find so excellent an authority as Major Alvord giving preference to the "old, quiet gravity method," because of the "lesser disturbance and change of the fat globules of the milk." As to this last claim, the writer would require more than an opinion to convince him that in the process of aggregation that obtains in any system of creaming, there is any "change," in the globules, of the character of a breaking up of the globules, to be followed by a re-assemblage of them. There would be more reason to fear this new speedy gravity method if centrifuging milk were an active churning of the milk, at an extremely high temperature—say about 100 degrees.

The difficulty of deciding which of two creaming systems produces the best butter is due to the lack of reliable data. In butter-making there are various factors besides the creaming process; and it follows that the making of a good or a poor article by either system is not necessary proof of the superiority of one system or the inferiority of the other. Good and bad butter have been made by either system. The making of a good article by any system proves the merit in respect of quality of such system. The making of a poor article, after such proof, simply suggests the probability of something important in the general management of the cream and butter. Each system demands different treatment of the cream; and doubtless to this fact is due an occasional failure in either case. The writer, while he is not prepared to urge any marked superiority in the centrifuge in respect of quality of product, does not hesitate to affirm his perfect confidence in the system on the score of this important essential.

Points of Merit in Cream Separators :—

First. Strong and simple in construction; safe and easy in working.

Second. A good strong foundation, and a steady motion. The danger in the machine lies in the chance of the breakage of the skimming vessel, or drum, which revolves with greater or less speed. This should revolve within a strong metal armor, or shell, which will serve as a protection.

Third. The minimum need of power.

Fourth. Thorough skimming. It should be capable of separating the maximum quantity of fat from the milk, the cream yet containing the minimum quantity of milk. This is required because it would be a proof of merit in the machine, not because the skim-milk in the cream is in itself necessarily objectionable. It should have merit in the special quality of thoroughly creaming the *first* and *last* milk of the skimming.

Fifth. Easy means of regulating the flow of milk and cream, obtaining thin cream or thick cream at will.

Sixth. Easy cleaning.

Seventh. Freedom from defects in its mechanical construction, running, motion, inflow and outflow, oiling, heating, loss of speed, starting, etc., etc.

Eighth. General conveniences of detail.

Ninth. Cheapness and durability.

How to run a Separator. The centrifugal force is due to the *speed* of the revolution and the *size* of the drum. The larger the drum, the less speed required, and *vice versa*. A machine is constructed for a given speed. This speed, in practice, must needs sometimes vary. The greater the speed, the more complete the creaming for a given *inflow* of milk. In regulating the speed, the following general rule may be observed: *When the speed increases, the inflow of milk may be increased; when the speed decreases, the inflow of milk should be diminished.* Of course, it will be necessary to have a care not to increase the speed beyond safe limits.

Again, the creaming of milk by centrifuge, even as by s[illegible], depends upon *temperature.* The higher the temperature, at least up to 90°, the more eas[illegible] separation. This makes it advisable to cream the milk when warm. If, however, it be sometimes necessary to cream milk when cold, it will be also necessary, in order to avoid loss, to skim *more slowly*, or in other words, to diminish the inflow.

Care of the Machine. Like any machinery, it should be kept *well oiled;* and like any other milk-implement it should be always *immediately* and *thoroughly cleansed after each time of use.*

Special points in the management of particular machines may be learned by a perusal of the circulars of the manufacturers.

CARE of Cream. Ripening Cream. From the time cream is separated from the milk it undergoes constant change. The solids in the cream, other than the fats, are subject to rapid decomposition. This decomposition is not favorable to the keeping quality of whatever it affects. Butter always contains a proportion of solid matter that is not fat, and the less this solid matter has advanced towards decomposition, the longer will the butter keep. Now, this decomposition in *milk, or cream*, is very rapid. In *butter*, owing to the smaller quantity of this foreign solid matter, to its dryer condition, and to the salt, the decomposition is comparatively slow. Hence a very short time of change in the milk, or cream, represents a very long time in the life of the butter.

The facts go to show that the sooner cream is made into butter the better will be the keeping quality of the butter; for the rapid decomposition going on in the cream is partially, if not wholly, arrested in the butter.

On the other hand, the chemical changes in the cream appear to have the effect of aiding in the separation of the caseous matter from the fats of the milk, and so facilitating the churning. It has been pretty well proven that cream which has been subjected to the changes indicated, in other words has been *ripened*, will churn more easily and produce more butter. According to Prof. Long, experiments made on a large scale prove that to make one pound of butter it required 35 pounds of milk when sweet milk was churned, and only 22 pounds of milk where ripened cream was churned.

These two main conditions seem to have opposite effects, the one favors immediate churning for quality's sake; the other requires age, for quantity's sake.

It must be remembered, however, that the large weight of butter from sour cream is not all due to more effective churning, but may be partially due to the larger adulteration of the butter, with water, caseine and sugar, or acid.

Again, while these chemical changes are going on, there is a *development of flavor* in the butter. This development is doubtless due to such chemical changes as the decomposition of the caseine, the formation of lactic acid, and the oxydation of the fats. This development of flavor, up to a certain point, is agreeable to the taste. It is a more positive flavor, as compared with the delicate flavor of the sweet-milk butter. Beyond this point, however, the development continues till the flavor is sharp, or even rancid.

It may be accepted, then, as a general rule, that the newer and fresher the milk, or cream, when it is churned, the more delicate will be the flavor, or the less will the flavor be developed; but the less will be the quantity of butter.

As to the keeping quality, there is some room for question. It has been claimed that the keeping quality of sweet-cream butter is not so good as that of sour-cream butter. So much depends upon the other processes that it is difficult to say just what effects are due, in experiences cited, to this factor of chemical changes in the cream. One thing, at least, is beyond question, and it is this: that the eating, keeping, and every other quality is injured by keeping cream till it is *too old.*

The foregoing theory of cream-ripening, therefore, is not favorable to the practice of keeping cream very long, nor till it is very sour; nor, on the other hand, is it favorable to the churning of milk or cream absolutely fresh or sweet. It favors, rather, a moderate ripening, and churning not later than the first appearance of acidity. The fresh side is the safe side: it means more delicate flavor, better prices, increased consumption.

Ripeness is sometimes confounded with souring. It is quite possible that the chemical changes produced on caseine by souring have a tendency to weaken the adhesion of the caseine to the fat globules. But the real advantage of ripening, and the meaning of ripening, is exposure to the air, or to the oxygen of the air. Cream perfectly sweet that has been so exposed, will churn and make butter that has the merit of sour-cream butter, without the defects of souring—or decomposition.

Cream-ripening requires the following conditions:—

First. A certain *age*, and as much *exposure to the air* as possible. The higher the temperature during exposure, the more rapid the ripening process. Thus the temperature of the cream may be raised to 70°, and it may be stirred frequently while exposed to the air at that temperature, with the effect of hastening the process. In such case the cream is cooled just before churning. If it be an object to delay the churning, let the cream stand at a lower than the usual temperature, until ready for churning.

Second. Cream should be *ripened uniformly.* We have seen that well-ripened cream will churn in a shorter time than unripened cream, and produce more butter. It follows, from the fact that the ripened cream is the first to churn, that if cream be unevenly ripened, some of the cream will be farther advanced than the rest, and will churn first, leaving some of the butter in the buttermilk. Hence, a loss in quantity results from the cream not being evenly ripened; and it is a loss greater than would be supposed by dairymen who are not accustomed to make experiments, or to make careful observations. The lesson to be learned is to see that the cream be *evenly ripened*. Dairies are very often too small to allow of churning each milking by itself. It is necessary, therefore, in such cases, to mix different milkings. Under this practice, the cream, being of different age, is likely to have different degrees of ripeness. The oldest cream will be sooner churned than will the newer and fresher cream. The loss due to this cause may be provided against, in a measure at least. Let each fresh skimming of cream be mixed with the cream previously gathered, and let the whole be *well mixed* by thorough stirring, at the time of mixing, and by frequent stirrings between mixings. After the last lot has been mixed and well stirred, let the whole remain for not less than twelve hours at a temperature of about 60°. By this means the souring or ripening of the older cream is checked by the presence of the fresher cream, and the ripening of the latter is hastened. To accomplish this, all the cream for a single churning should be kept in a single vessel, which should be sufficiently large for the purpose. This will ensure a more even ripening, and provide against loss. The lower the temperature, the longer the time required to ripen cream. There is a practice, very common, and sometimes in vogue even among makers of good butter, of creaming on the morning of churning, and adding the fresh cream. This serves to enrich the butter-milk, but it is a loss and waste of butter.

The question of **Sweet vs. Sour Cream,** so much discussed, may be said to be settled in ordinary practice by this necessity of churning different skimmings. Where different skimmings are churned, and time is given for thorough mixing and even ripening, the cream is likely, under ordinary conditions, to have advanced, when ready for the churn, to a perceptible acidity. When it has arrived at this stage, the need for quality demands that the butter be churned, and there is no advantage to be urged to set aside this demand.

The **Length of time Necessary** to ripen cream depends upon two conditions: upon the exposure to the air, and upon the temperature. The more surface exposed to the air, and the more thorough and frequent the stirring, the better and the more even the ripening. For the sake of such exposure the cream-holder should be ventilated, but this ventilation will make necessary frequent stirring to prevent over ripening (and drying) of the surface. As to temperature, the higher it is the more rapid will be the process of ripening.

In large dairies in Denmark, churning is done once daily. The cream is churned after it has "ripened or soured 24 hours." It is the practice sometimes to hasten the ripening somewhat, in order to get the cream sufficiently advanced for churning. This is done in some cases by adding about two per cent. of sour butter-milk, keeping the temperature low, say 55°. A more common, and far better practice, is to warm up the cream to 65°, and keep it slightly above 60°.

The writer has never practiced putting sour butter-milk into cream. Nevertheless the practice is recommended by some dairymen. The churning in some cases is somewhat difficult, and relief is sought by adding, say from two to five per cent. of buttermilk to the cream just before churning. If any benefit arises therefrom, it is when added to unripened or sweet cream, in which case the churning is made easier perhaps, and the development of flavor is hastened.

Temperature for Keeping Cream. When churnings are somewhat frequent, a good temperature for keeping cream would be from 60° to 50°. Where churnings are delayed and cream is long kept, let the temperature fall to from 50° to 45° When churning is to be hastened the temperature may be from 60° to 70°.

Salt in Cream. It is a practice of some good dairymen to add a little salt to the cream. This practice is to be commended, especially where cream is kept several days before churning.

Consistency of Cream for Churning. The cream from the shallow pans, which has stood long, and has dried and thickened, would be improved by the addition of fresh liquid—skim-milk or water. There are two reasons why cream should be somewhat thin. The main one is that it allows the more thorough drainage, or washing, of the butter, as described later on. This may be provided for by adding milk or water at the close of churning. It is well, too, that cream be somewhat thin during the process of churning; the grain of the butter will thereby be better protected in churning. Especially should tough, leathery cream, taken from shallow pans, be thinned enough to dissolve the lumps in churning. This necessity for cream to be somewhat thin is an advantage; for the milk nearest the cream, when skimmed, is more or less rich, and by taking it up with the cream a saving is made. It is not so necessary to thin the cream raised by deep-setting at a low temperature.

The addition of water to cream has been objected to by some dairymen, and is favored by others. There can hardly be any harm in the practice, if the water be pure; and it is likely that the water will help to dissolve any excess of caseine.

To keep cream till it is very sour is a practice not to be recommended, as the reader has already learned. If it be done, however, it will be well to allow the sour milk in the cream to settle in the cream-holder, to draw it off at the bottom, and to replace it with *fresh* skimmed milk, or water.

How to Warm and Cool Cream. Always warm and cool cream *gradually*. The temperature of the cream may be changed a degree or two, by using very cold or very warm water in rinsing the churn. When necessary, or advisable to *thin* the cream, the temperature may be lowered or raised by using a liquid (milk or water) that is cold or warm, as the case requires. Avoid using a liquid that is *hot*, unless it be put in slowly while stirring the cream.

Again, the cream itself may be cooled or warmed to the necessary degree. This may be done either by setting the cream-holder in another vessel surrounded by cold or warm water, or by immersing a vessel containing cold or warm water in the cream till the desired temperature has been obtained; constantly stirring the cream in either case.

A Cream-Holder. Tin is one of the best materials for a cream-holder. It is light, cheap, easily cleaned, and it is adapted for changing the temperature of the cream, by being a good conductor of heat. It should be well made, of good, strong tin, with a ventilated cover, and preferably with a faucet at the bottom, and should be provided with side handles, placed well down towards the middle. A strong paddle is necessary, for stirring the cream. It would be well if this paddle were of some such material as glass or tinned iron. Hard wood will do, but it will be less easily washed. A hole in the cover of the holder will be convenient for the handle of the cream-paddle to pass through. A cream-holder should be sufficiently large to hold a *full churning*.

CHURNING. Of all the processes in butter-making, this one of churning is in some respects of the greatest practical importance. Indeed, it may be truly said, in a sense that would not apply to any other process, that churning is butter-making. This is so true that the writer does not hesitate to ask the reader to give his first and best attention to this section of the present work.

There are more reasons for this emphasis than space will allow being given. There is room, however, for one of the reasons. It is claimed that the great bulk of butter made in private dairies is poor. If this claim be true, or nearly true, is there any single process in the whole art of butter-making which, if corrected, would so change the bad state of things that one might be enabled truthfully to say that the great bulk of the butter made in the private dairies of the country were of excellent quality? There is one such process, and only one! It is not milking, it is not cream-rising, it is not creaming, it is not salting, it is not packing. However important all these are to the attainment of the desirable degree of perfection, it cannot be said of any one of these processes that it will do what is here claimed may be done by one other process: and that process is CHURNING!

This statement needs one single qualification. Churning, as here understood, is made to include the after processes called *washing* and *salting*. This is a reasonable qualification, since the whole work may be done by a single implement—the churn—and done at one and the same time—practically as a single process. The process of churning, as it ought to be understood, and as it will yet come to be understood, involves both the washing and salting.

It is at least true that one may go into any of the dairies of the country, take the cream *as he finds it*, churn it as it should be churned, and produce a sample of butter that would be pronounced first-class. It would be required, of course, that the one implement which he is to use be a good one, and that the ordinary requisites for the process, thermometer, salt, water, etc., be suitable. Beyond this, it is required only that the cream be not already *spoiled*, although not required that it be free from defect. In a word, one may go into the *average* dairy where the ordinary make of butter is poor, take things as they are—the cream probably defective, and other things not as they should be—and, by the sole difference of a *better process* than the one usually employed in that dairy, produce an article that if not gilt-edged will be of good quality—of a quality that if it were to characterize the butter of the country, would change the reputation of this butter of the country right about from bad to good!

It may be further said that the new process will be simple and easy enough to enable the average dairy operator to adopt and follow it. These are strong statements; but they are made advisedly—made with an assurance that their truth may readily be demonstrated by experiments which may be easily made if practical demonstration were necessary. If these be well-grounded statements, they are sufficiently important to justify the emphasis here given to them.

But while it is one thing to go in person into a dairy and accomplish certain results, it is quite another thing to send a book with a view to the same end. The question arises, is it possible for one to set forth in a book the better process so clearly that the book itself may go into hundreds or thousands of the dairies of the country and lead to such a change in this key-note process in butter-making, called churning, as will change the character of the butter from bad to good.

Though not with the assurance just expressed in regard to what may be done by a visit in person, the writer will *try* hopefully to make the explanation of a simple, scientific process of churning so plain that it will be possible for it to be studied, understood, and put into practice, by thousands of the many intelligent dairy-folk whose present process is open to radical improvement.

While it will be necessary, of course, to explain the whole process of churning, the attention of the reader is directed particularly to some of the more important parts of that process, especially the drainage, or washing, of the butter in the granular form.

Tempering Cream. Temperature for Churning. It is a common practice of dairy writers to name a certain temperature for cream for churning. The temperature most frequently given is 62 degrees. As a matter of fact, there can be no regulation temperature for all cream. Doubtless for every lot of cream there is a certain temperature which is best for it; but that best temperature would not be the best for other lots of cream.

To guide the operator in this matter of temperature for churning, it may be stated in general terms that the higher the temperature the more quickly will the butter come, but the poorer will be the quality of the butter; and the lower the temperature the longer will it take to bring the butter, but the better will be its quality. This will hold good at least within the *average range* of churning temperature which may be said to be between 55° and 65°. The rule which the writer has adopted is to *churn at as low a temperature as will bring the butter, and within a reasonable time.* For the sake of quality of butter, and perhaps quantity, it is preferred to *lengthen* rather than shorten the time of churning.

This is an easy and a safe way of determining the question of temperature. The time required for churning is under perfect control, and the rule is simple. To hasten the churning, warm the cream; to retard the churning, cool the cream.

The only way in which one is likely to err, is in churning in too *short* a time. Where one can bring the butter in as short a time as he will, by merely raising the temperature of the cream, he is not likely to make the churning too long. In the experience of the writer, the only evil connected with slow churning has been the unnecessary labor involved. On the other hand, quick churning, except it be due to the favorable character and condition of the cream, has the effect of materially injuring the quality of the butter.

It is desirable that the butter when it "comes" be firm, not only for the sake of its quality and quantity, but for the need of carrying out the whole process of washing and salting. This requirement can be met only by churning at a low temperature. Although a low temperature means slower churning, it has so much to recommend it that a trial is strongly urged upon the reader—a lower temperature than what may have been his practice—even so low as 58° to 55°, under favorable conditions.

It may be here noted that if it has been necessary for any reason to churn at a somewhat high temperature and one which does not leave the butter firm, as sometimes happens when cream is peculiarly difficult to churn, it will be very advantageous to *cool the contents of the churn, towards the end of the churning*—as soon as there is evidence of the "breaking" of the butter. This plan has merit second only to that of doing the whole churning at a low temperature, but it requires judgment.

It sometimes will be found necessary to vary the temperature, owing to causes which it is well for the operator to know. The cream of some cows and some breeds is easier to churn than is the cream of other cows and breeds. The earlier after calving and the more succulent the food, the easier will be the churning. It is well known that the milk of cows fed on dry food in winter, and having been milked for months, will be more difficult to churn, requiring a higher temperature of the cream, or a longer time to churn, one or both. The better the condition of the cream, in respect of the ripening; the less the quantity of cream in a churning; and, to a certain point, the larger the churn, the more quickly will butter come.

Where the churning is difficult, it may be helped, at least in some cases, by heating the new milk before setting it. Again, account must be taken of the fact that the agitation of churning itself raises the temperature more or less. How much the temperature of the cream may change, will depend somewhat upon the surrounding atmosphere. In the warm days of summer, unless churning is done in a cool room the rise is considerable. In winter, if the churning be done in a very cold room the temperature may actually fall. Owing to such changeable conditions as those enumerated, it becomes necessary to vary the temperature at different times.

And yet the question is not so complicated as it may appear. While it is well to know these influences, one does not need always to take them into account and nicely to balance them. It is enough to remember the simple rule already given, to *churn at as low a temperature as will bring all the butter and in a reasonable time.*

In winter, to avoid a wearisome length of time in churning, it will be found necessary to churn at a higher temperature than that of summer, especially where the cows have been giving milk for months and the feed is somewhat of a dry character. In summer all the conditions are favorable to churning at a very low temperature. If, however, a regulation temperature be imperatively demanded, let it be from 55° to 58° in summer, and 58° to 62° in winter.

The temperature for churning sweet cream will need to be somewhat lower than that for sour cream, in order to avoid loss of butter, and the time required to bring the butter will be longer.

The **Rule for Time** in churning must be like that for temperature—a general rule. The conditions which demand a higher temperature are the same as those which demand a longer time. In summer, when all the conditions are favorable, the time of churning may be fixed at from 20 to 45 minutes. In winter when the conditions are usually very unfavorable, the time may be extended to from 35 minutes to one hour. There are some ways of shortening the time required that are not to be recommended. The objection already has been made to shortening the time by raising the temperature unduly, or to a degree that will injure the quality of the butter. Another objection must be urged against seeking the same end by the use of churns made on the principle of a threshing machine.

In considering the question of time in churning, there is one other important factor to be taken into account. By the temperature one may very easily shorten or lengthen the time of churning; by the same means he may also regulate both the *quantity* and *quality* of the butter. No explicit directions as to temperature may be given to apply to all circumstances, and the operator must rely mainly upon his observation to attain best results. A few general facts, however, may be stated to guide him. As a rule, the lower the temperature and the longer the time of churning the better will be the separation of the butter. The higher the temperature and the shorter the time, the more imperfect will be the separation of the butter; and the *more will the butter be adulterated with foreign matter.* In noting the *quantity* churned, therefore, it is necessary to observe *quality;* the excess of foreign matter may make it sometimes appear that the highest temperature has produced the most butter, when the fact is to the contrary. In comparing creams of different character, as for instance sweet cream with sour cream, *each cream should be churned at its best temperature*, or, one might say at *its own temperature.* To churn sweet cream at a high temperature will result in shortening the time of churning, but it will result in a loss of butter.

Preparing the Churn. The Churn just before use always should be *well scalded.* In winter, or when it is desired to raise the temperature of the cream, this scalding will help to do it. In summer, or when it is desired to lower the temperature, it will be well after scalding the churn, to give it a thorough rinsing and cooling with cold water.

The object of scalding and rinsing the churn is not to clean it; for it is supposed to have been cleaned at the previous churning, and to have been kept clean since. The object is to so thoroughly saturate the pores of the wood that they cannot absorb the least cream or butter-milk, to absorb which is to *spoil the churn.*

Filling the Churn. Do not over-fill the churn. The *cream capacity* of a movable-body churn is a little less than half what the churn will hold; that of a stationary-body churn will stand a little more than half what it will hold. This is true after the cream has swollen, for which allowance must be made.

Delayed churning is very frequently due to an overfilled churn. This is especially true of the best class of churns, or movable-body churns, in which there are no dashers.

It is better that the churn be filled less than its cream capacity than that it be overfilled. Little harm can come by having too little in the churn; so there need be no weariness of slow churning due to an overfilled churn. The remedy is easy—a larger churn, or more frequent churning.

When the churnings are small, so as to fill the churn only one-third, or less, the churn will work all the better.

Coloring. The best way to color butter is to select good cows, and to give them the food that will make a fine, *natural* butter-color. If artificial coloring be used, let it be under the following conditions:—

First, that it be a commercial necessity, or add to the value of the butter, and make it sell more readily. The market certainly gives preference to good color, whether it be natural or artificial. Where a direct connection is maintained between the consumer and the producer, it may sometimes be to the advantage of the producer always to supply butter of a natural color.

Second, that the coloring be tasteless and harmless. The natural flavor of butter ought to be its best flavor. Only a poor butter flavor should be hidden.

Use only the best brands of butter-color in the market, which seem now to be all that one could ask.

Coloring is best applied *to the cream*, and *just before churning.*

For quantity, follow the directions that are given with the article itself, always keeping on the safe side, using too little rather than too much. An under-color will pass; an over color is repugnant to the eye. Our customer is a strange creature; though he wishes us to color our butter, he wants his eye to be deceived by the most perfect imitation of nature possible.

The Agitation of Cream in Churning. After cream has been allowed to ripen, the hold of the caseous or albuminous matter (that seems to attach itself to the butter fats) becomes weakened. If, now, the cream be subjected to agitation at a certain temperature, the foreign matter seems to be rubbed off by the concussion to which the fat globules are subjected. Measurably freed from this foreign substance, at a time when the temperature is favorable to this coalescence, the fats unite more readily and more closely than they could unite in the milk or cream. Continuing the agitation, the union of the fats goes on from invisible particles to large particles, to lumps and larger masses, which masses are removed from the serum, or fluid, of the milk or cream, and are called **Butter.**

There is more analogy than is sometimes supposed between churning and cream-rising. Churning, as a process, appears to be merely a continuation of cream-rising. One is cream-separation and the other is butter-separation. Cream is butter still mixed with milk; butter is cream with the milk more completely separated.

Explicit directions for manipulating the churn that will apply to all churns are not possible, and are hardly necessary. One who cannot in practice learn the best motion for one's own churn, will hardly profit by written instructions.

Ventilation of Churn. Cream, when agitated, begins to expand, and evolves a gas which, if confined in an air-tight vessel, exerts a pressure upon the vessel. The extent of this expansion and pressure depends upon the stage of advancement of the cream in souring. The more sour the cream, the more gas. This expansion is marked at the very moment the cream is first agitated, and if relieved by providing vent for the gas to the air, will not be very noticeable at the latter stage of agitation. If one will churn sour cream in a bottle, closed tight by a screw-cap, the cream will be seen to pass out between the bottle and the cap. Where a churn has no provision for free access of air to the cream, it is necessary to stop the churning a few times, at the beginning, and open the churn to the air in some convenient way, which is generally the removal of a stopple or plug.

Handling Granular Butter. We have arrived at what is at the present day perhaps the most important point in scientific butter-making. We are about to describe a practice that has more to recommend it than space will allow making mention of. It is a practice which is now followed out, to a greater or less extent, by the successful butter-makers of the day, or those who are always ready and willing to learn, and a practice to which much of their success is due. It is a practice which has only to be adopted by thousands of unsuccessful butter-makers to-day to place them well along towards the front rank.

There seems to be no point in the management of the dairy upon which there is not more or less conflict of opinion amongst dairy writers, with one exception; and that exception is this practice which we might call churning granular butter, as opposed to what we might call over-churning and gathering into lumps.

In "Scientific Butter-Making," the writer, by elaborate explanation and liberal quotations of successful practices, gave special emphasis to this improved churning system. Rather than having changed his opinion on this score, he is more than ever impressed both with the correctness of the position taken, and with the importance of the process.

Experience, indeed, leads him to go farther than before, in the same direction. Let us then, compare the two methods—the old and the new.

In **The Old Practice**, the churning is continued, after the butter has "come," until the butter has gathered into one or more large lumps so that it is easily lifted out of the butter-milk. These lumps necessarily contain a considerable proportion of butter-milk. This butter-milk is filled with caseous or other solid matter, and if the cream, as is too often the case, has been in an advanced state of souring, possessed of taint or odor, or otherwise defective, the butter-milk contains all the objectionable characteristics. These lumps will require to be worked, or pressed, in order to remove the butter-milk. This pressing will leave in the butter a *considerable quantity of that butter-milk*, and, doubtless, an excess proportion of the objectionable characteristics of the butter-milk. Manifestly, all that can be removed by pressure, is a portion of the water of the butter-milk and what that water contains in fast solution. The very process of kneading must have the effect of incorporating in the butter, permanently, a considerable proportion of solid matter, perhaps in an advanced state of decomposition, and perhaps tainted with impurities. The kneading of the butter has had the effect of squeezing out a part of the liquid, solidifying the butter, and incorporating with it the strainings, as it were, of the butter-milk which it held. It is impossible by this system to free the butter from what will seriously depreciate the taste, and hasten its change or spoiling.

The pungent taste of butter-milk in the butter may be pleasant to the palate accustomed to it, but the delicate flavor of the butter itself is more pleasant to the lover of butter, as a real luxury. In any case, that taste is not long pleasant to any palate, but hastens on to rancidity.

As to keeping-quality, it depends, more than any other one thing, upon the *entire removal* from the butter of the butter-milk, and what the butter-milk contains. Butter is mainly a fat. Fat, purified of everything foreign, has the quality of long-keeping. Salt having no chemical affinity for such fat, does not help it to keep. On the other hand, the solid matter contained in butter-milk has no keeping quality. This solid matter is largely caseine and albumen, nitrogenous substances, which are short-lived. Salt does have some preservative effect upon this caseous matter. When salt is used in butter for its preservation effect, it is because of its action upon whatever of this nitrogenous matter there may be in it, and not upon the fats.

Butter *at its best* will contain some of the solid matter of butter-milk, or what we may call *foreign matter*. The proportion of this foreign matter will be more than abundant for any need of it as a direct influence upon the flavor of the butter, and will require for its preservation quite as much salt as is necessary for the eating quality of the butter.

If butter be not at its best, that is, if it contain foreign matter, which ought to be excluded in the manufacture, it suffers by the direct effect of that foreign matter upon the flavor, and from the necessary addition of more salt than its eating quality demands. It suffers again in its keeping quality; for while butter, even without salt, is slow to change, the foreign matter is so quick to spoil, that salt even in great excess may not wholly cure it, but will only retard the change.

From the foregoing it will be seen that if made to contain an undue proportion of foreign matter, butter will require, in order to preserve it, so much salt that the fine flavor of the butter will be destroyed, and even then its time of keeping will be limited, because of the presence of this excess of foreign matter, which called for the salt, and which salt will imperfectly preserve. The eating-quality of such butter will be poor, and its life will be shorter than that of the other and purer butter that has been less salted, or, perhaps, not salted at all.

Thus it will be seen that the old practice of gathering the butter in the churn is a very defective practice, because of the fact that it adulterates the butter with what injures it in every respect.

That practice is defective in still another respect. Most butter must be salted. However little salt is used it is required that the salt be thoroughly incorporated with the butter, or that it be mixed evenly through it, and that the grain of the butter be not injured by the process of salting. Now, when butter has been gathered into large lumps, before it has been salted, it must needs be pressed into thin layers, the salt spread theron, these layers pressed together, rolled into lumps, pressed again, and the operation continued till the salt permeates the whole mass, as evenly as this sort of manipulation can make it do so. This process is defective, because of the double reason that it does injury to the grain of the butter, and requires no little skill on the part of the operator to succeed only partially in distributing the salt evenly throughout the mass of the butter.

In **The New System** the defects just explained are avoided. There is a stage in the churning process, at which the objectionable *butter-milk*, and the *objectionable matter which butter-milk contains*, may be *quite fully removed*, and at which the *salt may be very evenly* *incorporated* with the butter, *without injury to the grain* of the butter. That stage is when the butter is yet in a granular or *pebble form.*

When butter first "comes" it is in small specks, throughout the whole body of the cream. The continued agitation of churning causes these specks to unite to form larger particles, these again to join; this process repeating itself until the butter is in large lumps. Now, while the newly-churned butter is still in a granular form, that is, like seeds of grain in size, the churning is discontinued. The butter has not yet enclosed within itself a large proportion of butter-milk, and it is yet in a granular or pebble form, just adapted for the mixing in of the salt.

Stopping the Churn. If every reader of this work were supplied with the same sort of churn, it would be comparatively easy to describe the process now referred to; but as things are, it is necessary to explain both the process and the principles involved.

This process is based upon the fact that butter is lighter than butter-milk, or water, and, consequently, if left to itself will rise into the upper portion of the butter-milk, as cream rises to the surface of milk, but with greater rapidity. It is due to this fact that we are able to separate the butter from the butter-milk. It allows of either skimming off the butter, or of drawing away the buttermilk from the butter. The latter is the usual and better plan.

To make the explanation more clear, it will be well to describe the process with one class of churns, and the reader by the help of the principles laid down, may adapt the explanation to the churn which he happens to possess.

There is one churn which has peculiar merits in this and in any connection. It is in the market almost everywhere, and the plain form of it being common property, the reader may make one for himself if he finds it to his advantage to do so. These are all-sufficient reasons for describing this process in connection with such churn. Reference is made to the *revolving* churn, which may be either a revolving box, or a barrel, revolving end over end.

There are several ways of observing the state of the cream in the different stages of churning.

One guide is the *sound of the liquid,* when churning. At the beginning, the churning liquid has a thick, creamy, muffled sound. When the butter "breaks," this sound changes to a thin, watery, swishing sound. This change is very decided, and apparent to the practiced ear.

Where the churn has a *glass* in some part of it, the change will be noticed by the appearance of the cream thereon. The creamy, or frothy, character will disappear, and the glass will be somewhat clear, or be covered with a watery liquid. The specks of butter will appear on the glass, constantly growing larger and larger. After a little, the granules become so large that they do not remain on the glass. The sound of the churning cream, or the appearance of the butter through the glass, do not always indicate to the operator that the churning is done, but either test will afford a warning that it is nearly, if not quite, done.

There is another and an excellent guide. One may stop, from time to time, after the sound has indicated that the butter has come, and examine the *end of the wooden plug,* or stopple, of the churn. The end of this stopple which, until the butter "broke," was covered with cream and probably frothy, will now be covered with small pin-point specks of butter. These will grow larger (as they do upon the glass), and after they have become of a certain size, they no longer gather upon the plug, which will be quite clear.

Churning should proceed very slowly from the time that the sound indicates that butter has "come," and more cautiously from the time that the glass or the stopple are clear.

There are now two ways to know when the churning should be stopped. One may examine the *appearance of the butter,* by removing the cover. The indication of finish is the appearance of the butter on the surface of the milk, in a pebbled mass. Or, one may partially remove the stopple, and allow the milk to flow out *into a strainer.* If the milk is thick and still full of specks of butter, it is evidence that the churning has not sufficiently advanced. If, on the other hand, the milk is thin and watery, comparatively free from butter grains, and drains freely through a cloth strainer, or a wire strainer (somewhat coarser than a milk strainer), the churning may stop, and the butter can be easily managed. This is one of the very best tests of the time to stop churning.

When the churning is nearly done, one must proceed very slowly. Sometimes it will take longer than at other times to bring the butter to the right stage of advancement. The reader readily can understand that when the churning conditions are favorable, and the time required for churning is short, greater caution will be necessary than when the butter is slow of coming. *Easy-churned cream* (like the grass cream of summer), a *high temperature,* or a comparatively *small quantity of butter-milk,*—all tend to hasten the massing together of the butter, and make caution very necessary. Opposite conditions, such as those usual to winter, allow greater time. Experience soon makes one familiar with the action of the butter, and enables one to know when to stop churning without going to the trouble to remove the cover.

Granular butter can be managed, by one who is experienced, even when it is very fine, say between the size of pin-heads and grains of wheat. The beginner, however, is recommended to allow the churning to advance a few degrees, till the butter is between the size of wheat grains and peas. Gradually, as experience is acquired, the churning may be stopped earlier, when the butter granules are finer. The smaller these granules, the more *effectually is the butter freed from the butter-milk;* but on the other hand, the smaller the grains, the *more difficult is its management,* and the more risk of losing butter, by the loss of unchurned butter, or by the escape of the finer granules in the butter-milk. A little experience will help one to find that happy medium where quality is secured without appreciable loss in quantity.

Separation of Buttermilk from Butter. The writer has met with butter-makers who had read of granular butter-making, had tried to follow out the process, and had failed. The chief difficulty lay in the tendency of the butter to mass together. There are a few facts, the knowledge of which will enable anyone to avoid any difficulty, and to manage granular butter quite easily.

The main fact is the influence of **Temperature.** There is a degree of temperature with every churning of butter at which, or above which, the butter will mass together when agitated, or churned. The higher the temperature above that point, the more rapidly will the butter mass together. Cream has to be churned at or above that temperature, else the butter would not gather. There is, too, a degree of temperature at which, or below which, butter will *not* mass together, no matter how much it be agitated or churned (provided it be contained in an abundance of liquid—milk or water). The lower the temperature below that point, the less disposition it has to gather (or the less liquid is required to surround it to prevent it gathering). This temperature which will allow of agitation of the butter without causing the butter to gather, is a *low* temperature—lower than that at which the churning is done.

In the first stage of churning it was an object to mass together the minute globules of fat, that they might form into larger granules, or, in other words, become visible butter. The temperature was chosen accordingly. When the granules have attained a certain size it is an object to *check* the massing together of the particles. At the same time it is necessary to subject the butter to further agitation. What shall be done? Simply *lower the temperature before further agitating the butter.* Through the stopple-hole of the churn, draw off what butter-milk will readily drain out of the butter, straining this butter-milk through a seive to save any fine particles that may be entangled in it. Have a care that the churn at this stage be not agitated at all. When the butter-milk is drained off it requires but little agitation to cause the butter to mass into one large lump. The higher the temperature at which the butter happens to be, the more care is required to avoid agitation. Now pour into the churn an abundance of (pure) *cold* water. Allow the butter to stand in this water until it has been cooled to the necessary degree. If the water be cold—say 50° or lower—the butter will need to stand only a few minutes. If the water be only a few degrees colder than the butter, say 55° or above, more time is required, also more care.

When the water is only two or three degrees colder than the butter, it may be necessary to draw off the first water, after it has stood a few minutes in the churn, and to renew it with fresh water before proceeding with the operation, or before agitating the butter. Where the difficulty is experienced of having water that is not very cold, say only 59° down to 55°, one needs to be all the more liberal as to the *quantity* used. The main point is to get the temperature low enough to *permit of the butter being agitated without causing it to "gather,"* or to mass together. How low ought that to be? The lower the better, anywhere from 55° down to 45°.

The writer has succeeded in carrying out the whole process successfully, even to the salting, to be described further on, and in warm August weather, when the water used was so high as 59°—the only water available! To accomplish the object under such unfavorable conditions required more care, more time, and a more liberal use of water. It proves, however, that the thing may be done under the conditions which obtain almost anywhere; for it is in few places, and for only short periods, that water may not be obtained at a lower temperature than 59°.

Having got the butter sufficiently chilled, whether it be in the first or second water, fasten up the cover of the churn, and *churn the butter in the water.* Churn it well, but gently. This water may now be drained off, as the butter-milk was drained off, and again renewed. This operation should be repeated until the water when drained off is almost or quite free from any appearance of butter-milk.

One should have a vessel of *cold brine*, previously made, ready (with the salt all dissolved) to use at this point in the final washing of the butter. Allow the butter to *stand in the brine* for a short time, say ten or fifteen minutes, giving the churn a few turns at intervals during the time. Drain off as before.

Run butter-milk, water and brine always into a strainer, or upon a strainer-cloth, in order to save the few particles of butter which are likely to escape.

It goes without saying that the water *must be pure.* The water, and *especially the brine*, should be run through a fine strainer, when it is put in the churn. One often will be surprised at the sediment that will be found in both the water and the brine.

The reader may vary the above process by substituting *brine* for *water* in the *first washing* (or cooling) of the butter. It involves very little extra pains, and the result will doubtless be even more satisfactory. The theory of this preference is that the salt of the brine, in the first washing, coagulates the albumen, and the water which is used in the subsequent processes dissolves the coagulum. If this reasoning be correct, the effect must be a very perfect removal from the butter of the objectionable albumen.

Where brine is used to coagulate the caseine, not to be followed by water, it is probable that the best effect is secured by the use of *weak* brine; for where the brine is of full strength, though its coagulable effect would be all the greater, its solvent effect must be less. In the last washings, the brine being required for its salting effect, the stronger it is the better. Probably the most simple and effective process is the use of the strongest brine, at the beginning and at the end, with water-washing between—as suggested in the preceding paragraph.

The object of using brine in the last washing is to permeate the butter as much as possible with salt in liquid form, which is more uniform salting than that with dry salt.

A tunnel that will fit in the stopple-hole of the churn will conveniently save the trouble of removing the cover of the churn at every washing, for the purpose of putting the water in the churn.

The reader will have noticed that stress was put upon the **Quantity of Water**, or other liquid, used in washing the butter. This matter of quantity of liquid is a point of importance next to that of temperature. Butter that will churn in a certain quantity of liquid, at a certain temperature, for hours, without massing, will mass quickly if the quantity of liquid be diminished one-half, even though the temperature remain the same.

This fact must be remembered, if one would avoid an occasional unexpected failure. For instance, one having drawn off a portion of the butter-milk, forgets that in this respect of quantity the conditions are changed, continues the agitation; and opens the churn to find the butter the size of birds' eggs or larger, instead of in the granular form. Again, one finds at his hand a partial supply of water or brine, it may be the water vessel only half full, instead of the needed quantity, and thinking it may do for once, agitates the butter in a partial supply of water, with the result, again, of over-gathering.

All this can be avoided by keeping in mind the fact that the gathering depends upon the *quantity of liquid*, as well as upon the temperature, and that there is no risk of using too much liquid.

There are two minor points to be noted. The *larger* the butter granules, the more speedily do they rise to the surface. When butter has first come the rising of the granules in the butter-milk is so slow that no practical advantage can be taken of their lightness. The resistance of the other solid matter in the thick butter-milk prevents the rise of the butter-granules, until the latter have become large enough to overcome the resistance. Consequently, if one undertakes to drain off the butter-milk at *too early a stage*, the butter-milk will be filled with the fine particles of butter and will not run through the strainer. The remedy is to *churn the butter a little longer*.

Thus the fact that the butter-milk will strain off freely, that is without being clogged with fine butter particles mixed all through it, is an indication that the granular stage has been reached and the next process of cooling and washing may be proceeded with.

The other minor point is that the *more fluid* the butter-milk, the more easily and the sooner will the granular butter rise to the surface. This fact affords a means of overcoming the difficulty of the butter not straining readily, other than that just mentioned. When the butter-milk is very thick, and when it is no object to save the butter-milk free from water, the way is open to *dilute the butter-milk*, with cold water or brine, when the difficulty experienced will disappear.

Sometimes the butter particles do not readily separate from the butter-milk, and there is a difficulty in draining off the butter-milk without advancing the "gathering" more than is desired. In that case, cold water or cold brine, added to the contents of the churn, will help to thin the liquid and cause the butter to rise to the surface. It will be necessary, of course to previously draw off what butter-milk is required, for use as butter-milk. One may sometimes prefer, too, to use cold skim-milk to thin the contents of the churn.

Let no one be discouraged at the length of these explanations. A little experience will enable any butter-maker to easily handle granular butter and keep it under perfect control. The advantages in the process are worth many times more than the trouble of obtaining the experience.

Butter for Immediate Use. There may be seasons of the year when the churnings are very small and the butter intended for immediate use in the family, when the advantages of granular churning are not so manifest. There can be hardly any other exception to the great improvement in every respect which it is upon the old system.

Salting. In the old practice, salting and "working" were distinct processes. In the newer system, now being described, salting includes working, or, it might be said, almost does away with what has been called working butter, while the newer process of churning might be said practically to *include the whole!* The butter is now in the churn, in granular form, at a low temperature, and moist with brine. This is in the very best condition for salting in the most perfect manner. All the conditions of light-salting are here afforded. The salt may be evenly mixed throughout the butter, it may be allowed to partially dissolve and so avoid the injury to the grain of the butter sometimes due to rough edges of salt crystals; and, better still, the "working" of the butter—be it the old-time kneading or the modern pressing—is made wholly unnecessary. In a word, the object of salting, which is the even mixing of the salt without injury to the grain of the butter, may be secured by this as it cannot be secured by any other process.

Pulverize the salt, with a rolling pin, or in any convenient way. Take about one-third of the salt to be used, and sprinkle it evenly over the top of the butter, which is now drained and spread uniformly over the bottom of the churn.

Use a small hand-seive, of very fine mesh, with which to sprinkle the salt on the butter. It will both help to sprinkle it on evenly, and serve to keep out from the butter more or less dirt that will be found mixed with most any brand of salt. If nothing worse, salt frequently contains fine threads, broken off from the bag, which may be mistaken for hairs. If one has not a suitable seive, it is easy to obtain the wire and make one. Or, one may have about the house a used-up common seive that can be cut down to a small and convenient size.

The top having been sprinkled, tip the mouth of the churn towards you as far as you can without disturbing the butter, and then by a quick motion, or jerk, tip it enough further to throw the butter over on the side of the churn.

What was the top face of the butter, and was sprinkled, is now beneath, and the butter

presents a fresh face at its top. Sprinkle on this fresh face of the butter about half the remaining salt. By another dextrous movement throw the butter over on the other side of the churn.

The evenness of the layer of butter will now be broken up, but there will be enough of fresh surface to receive the remainder of the salt. The salt is now pretty evenly distributed throughout the butter.

The churn now may be rocked from side to side, gently, to mix up the salt. The eye can easily watch the operation, and tip the churn in a way to make the mixing most thorough.

Do not hasten the operation, but give time both for the mixing, and for the salt to dissolve. The colder the butter the better can all this be done. If the butter be on the warm side, and disposed to mass in lumps, it must be treated the more gently, and more time given to it.

Having got the salt well mixed, it will be well to allow the butter to stand not less than 15 to 30 minutes, to allow the salt to dissolve. It will do no harm to give a longer delay, if the temperature of the churning-room will allow. After this short delay, put on the cover of churn, revolve slowly, and the butter will gather into lumps, and the surplus brine will be worked out. Let the butter stand in this condition for a little while longer, say about an hour, in a cool room.

The *churning is now done* and the butter is *ready to pack!* But does it need no further working? Not if the work has been done carefully, as directed. If the butter can be improved by a further pressing it will show for itself, and it will be well, of course, to give it what is required.

If the butter has any fault, that fault will be likely to be an excess of moisture, which may be removed, perhaps wholly, by the mere working it must get in being made into balls, or in being packed, provided in the latter case a sponge or cloth be used to drink up the moisture.

The process just described has been well tested. The mistress of the dairy, at a neighboring farm, has been making butter by this process for some weeks, and with results that are extremely gratifying to her. There was camping in a grove near this farm, during the month of July, a gentleman connected with the Government Geological Survey. This gentleman had found a difficulty in some of the districts where he had been working, in obtaining butter of fine flavor, and butter that would keep well in the camp, and he usually brought a supply from the nearest city. A day or two before breaking up camp he obtained a sample from this farm-house near by, and he was so much pleased with it that he ordered two packages of the fall make to be sent to him at Ottawa, making no stipulation as to price.

The mistress of this dairy is herself an excellent butter-maker, but this process is one newly-adopted. She is quite enthusiastic about her success by the new method, and could not be prevailed upon to go back to the old practice. This dairywoman has a very poor cellar, and water that, coming a long distance in pump-logs, is sometimes so warm as 59°, if not warmer. The gratifying results noted have been attained in spite of such double disadvantage.

Where the quantity churned is large it will be necessary to help the even mixing of the salt by stirring it in with a stick, which should be small and round. It may happen that the quantity is too large to be manageable in the churn, or the churn be not well adapted to the process. In like cases, take the butter out and place it on a butter-board or table. Sift on the salt evenly as possible, and stir it in with a stick, or a rake. If the table is large enough the butter may be well mixed by even a hay-rake—or a rake constructed like a hay-rake for the purpose. Again, one may lay a thin cloth on the table, or in a large bowl, or pan, and combine the lifting of the cloth and the stirring of the butter for mixing in the salt.

Another plan : Remove some of the butter and place it in a thin layer in a butter-bowl (or on a table, or a worker), and sift upon it the necessary quantity of salt. On this first layer spread another layer, and again sprinkle on the salt. Continue so doing until all the butter has been removed and salted.

Time is given, of course, in any of these operations for the salt to dissolve. While standing, the butter should be covered with a cloth wet with brine.

When the salt has been as well mixed and dissolved as need be, the butter may be gently pressed together in a solid form, and it may be packed directly into the tub.

Removing Butter from the Churn. Where necessary to remove the butter in the granular form from the churn, it may be accomplished in several ways, always provided the butter is chilled enough—down to 55° or below. The butter may be lifted out (from the butter-milk, water, or brine) with a seive-dipper ; or the butter may be dipped out with an ordinary ladle, and poured into a seive to drain ; or, after the brine has been drained off, the butter may be lifted out with a flat wooden paddle. Whatever way is most convenient may be employed, provided the butter is removed without injury to the grain, and without leaving butter jammed or sticking to the sides of the churn, or requiring injurious hand-contact with the butter.

Where butter has to be removed from the churn, however, or has to be stirred with a stick or spoon, a somewhat lower temperature is required than that necessary when mixing by rocking the churn. To handle the butter in such ways requires a temperature at least as low as 55°. It should be the aim, however, of every butter-maker to provide means for obtaining a temperature so low as this, or lower. Ice is the most satisfactory means, where the water of the spring is too warm. If one has a cold cellar, the water might be cooled therein, although this means extra labor. The different suggestions given above are necessary to meet the wants of different dairies, that each one may find a hint suited to the peculiar conditions of the place.

A **Cream Basis for Salting** Granular Butter. One slight difficulty occurs in this system, in the way of exact salting. In salting the butter in the churn, one cannot weigh the butter to determine with exactness the necessary quantity of salt. This difficulty can be overcome in a measure by estimating the quantity of salt, on the basis of the quantity of cream put into the churn. If one will note once or twice the quantity of salt used, in proportion to the cream, a basis will be arrived at which will make it easy to salt very uniformly.

CAUTION.—One must remember to use less salt when the butter has been washed with brine than when it has been washed only with fresh water. Where brine is used the butter is already more or less seasoned, according to the strength of the brine. Where fresh water has been used it dissolves some of the salt, and when pressed out will carry off some of the salt.

Brine-Salting. The use of brine is itself enough, without further salting, to season butter enough for some markets. Doubtless the time will come when brine-washed butter will be salt-seasoned enough for the demand of any table. For salting with brine alone, the brine may be as strong as it can be made, and even then it will be well to throw a handful of salt in with the brine. This salt will keep up the strength of the brine when it mixes with the fresh water already in the butter. The butter should be allowed to stand long enough for the salt to wholly draw out the fresh water, as it were, and replace it with brine. The conditions vary so much that no rule for length of time can be given. Uniformity of seasoning is secured by this method, as it cannot be done by the use of dry salt.

Brine-salting should always be practiced, and where it is not considered sufficient salting of itself, it may be supplemented by light salting to complete the seasoning.

Brine—Making and Keeping. Brine may be made in a few minutes by simply throwing a quantity of salt into a vessel of water. This brine will do good service, provided the water and salt be pure and good. A better plan, however, is to boil the water. Skim off any scum. Throw in a little more salt than the water will dissolve, leaving a little to settle on the bottom, undissolved. This will ensure a saturated brine, or a brine always of uniform strength. Let the brine itself come to a boil. Let the brine cool and settle, and skim the top again. When the brine has settled it may be poured off clear for use.

Such brine may be made at any time, and kept in a brine-holder or any suitable vessel for use when wanted. The brine should be kept in a cool, fresh place, and all dirt excluded by a tight cover. This plan will be excellent, in connection with the granular process, where one's supply of fresh water is not so cold as required; for this brine may be kept cold in a cool cellar. Such brine is required in any dairy, too, for covering butter when packed, and for similar uses.

Other Special Merits of the granular system of butter-making:—

First. The preservation of the **Grain** of the butter. It is not necessary here to enter upon the discussion as to what is the character of the butter globule. The view so long held that it is covered with a membraneous sac is giving way under the light of investigation. But, whatever disagreement there may be as to the reason therefor, there is no difference of opinion as to the fact that there is such a thing in butter as a grain.

The explanation has been that the fat globule is an organized structure, and when that structure is broken the grain of the globule is destroyed. The fact, however, does not depend upon sustaining this theory. Anyone who has seen the process of making maple sugar may have noticed something somewhat analagous to the manufacture of butter, in respect of grain. When the sugar is in a melted condition, and quite hot, if it be allowed to cool, with little or no stirring, it will possess a crystalized character that will make it marketable, and which will be spoken of, in common language, as the "grain." If a dish of this same melted sugar be vigorously stirred while it is cooling and hardening, it will possess a totally different character. It will differ from the other sample in hardness, in consistency, in texture, in taste, in color, so much so that one not knowing it would be likely to doubt the fact that the two articles were identical except in the one difference of the stirring given to one sample while it was hardening. The sample that has been stirred will be to the other sample something like what clay is to sand. Again, if the hot sugar be dropped in a thin layer on a cold surface, it will possess a stickey, candy character unlike the same sugar under the other treatment. In a few hours this, too, will crystalize, or "grain."

One familiar with this phenomenon can the more readily imagine the possible effect of pressure upon butter fats. The grain in butter, to whatever it may be due, is a *fact*, and the quality of butter is largely dependant upon that fact.

Ideal butter must have an unbroken grain. It is probable that any pressure between two hard substances must affect the grain, and unfavorably, to some extent. The more of that pressure, or the more it is of the character of grinding, the greater the effect upon the grain.

In the old method of butter-making, the aim of the best butter-makers was to work the butter as little as possible, and to do that working by gentle pressure, rather than by a grinding motion. This was the full extent that is was thought possible to avoid the evil—which was thought a necessary evil.

The new system goes further. It seeks to avoid, almost wholly, the necessity of working butter at all, or at least the necessity of working out butter-milk and working in salt. It allows only the necessary pressure there is in the fall of the butter upon itself in the churn, with a view to squeezing out the water; and the pressure necessary in shaping the butter for the table or market, or in the packing of butter in tubs.

Second. **Churning at a Lower Temperature**. It is a fault in the practice of some dairies to churn at too high a temperature during the warm season. The butter is soft and white, and it contains an excess of foreign substance. The making of granular butter demands that the butter be either churned at a fairly low temperature, or cooled immediately when the churn is stopped. In making granular butter the temperature must be under 60°, and ought to be under 55°. This necessity will urge upon butter-makers the practice of churning at a lower temperature, and doubtless will result in less butter being taken from the churn in a melting condition.

Third. It makes possible, **Uniform Packages in Small Dairies.** When butter is in the granular form, and well brined, it will keep in brine under favorable conditions for an indefinite length of time. It has been so thoroughly washed of caseous or albuminous matter, and is so well impregnated with and surrounded by brine, that if only it be kept at a low temperature, and the air be excluded, it will change very slowly.

Now there are many small dairies that are provided with a good cellar, and need only to be provided with some suitable vessel for keeping the granular butter, to be able to pack a full tub at a time, where now in a single package there may be several layers. This plan would have many advantages.

First, it would make the packages of butter more uniform and more marketable. There would be many excellencies in quality that would be due to pressing, salting and packing large quantities at a time, which could be done at the most favorable time and under the most favorable conditions.

Second, it would allow of more frequent churnings. The labor of each churning would be shortened. The work of salting and packing would not have to be done at each churning, but might be done once for all when enough butter had accumulated to fill a package.

Where this process is adopted, the butter, in its granular form, is put into a vessel of brine large enough to hold the quantity required. The vessel must needs be close-covered, and in a way to keep the butter always and wholly covered by brine, that is, under the surface of the brine. The temperature must be continually low, say 55° or below, and there must be an abundance of brine. The butter may be made almost fresh by washing it in fresh cold water.

Some attempts in this direction have been made with great success ; it must be admitted, too, that some attempts have met with failure. But enough has been done to establish the possibility of long-keeping, under favorable conditions. There ought to be little difficulty in keeping granular butter for the short length of time necessary to accumulate enough butter for a single churning. This is, however, a practice to be commended to the consideration only of the intelligent dairyman who is willing to go to a little trouble with a view to improving his process.

Fourth. **Correcting Defects in the Cream.** Granular Churning not only helps to improve the future working of the butter, but it goes back as it were and actually corrects defects that precede the process of churning. The cream is sometimes—far too often—defective, owing perhaps to its having been kept too long, or kept in proximity to impurities. The objectionable characteristics of such cream will be found at churning, *mainly in the butter-milk.* If that butter-milk once gets compressed into the butter it will never be wholly removed. If, on the other hand, butter-milk be quickly removed, it will carry away with it very much of whatever it contains of impurities, be they from dirt, age, atmospheric taint, or anything else objectionable.

The writer has seen produced from winter cream, that was bitter with age, a sample of butter that was pronounced very fine when placed on the table, unsalted. It was churned and washed in the granular form.

Fifth. **Saving of Time and Labor.** The Granular Process of churning may, to the inexperienced, be a longer process than the old process to which they are accustomed. But when one has once become familiar with the newer practice, it will be found that it is less laborious, and is a saving of time. The churning is stopped sooner, and it will require less labor to salt the butter than is required to work and salt it by the old method. There is some delay, perhaps, in waiting for salt to dissolve, but the busy butter-maker will always find something to occupy the time profitably.

This question of time, however, is one of the least importance of all. If a little extra time, or extra trouble, could be devoted to churning, and result in an improvement in quality of product, it would sometimes be the most profitable part of the whole dairy investment. Preliminary to churning is the keeping and feeding of stock, the fitting up of some sort of dairy room and utensils, the milking of the cows, itself no small item, the straining, setting and creaming of the milk, and the ripening of cream. The work of churning forms but a small part of the whole of this large investment of capital and labor. Would it not be short-sighted to object to a *little extra labor* in this one finishing process upon which the revenue of the whole investment absolutely hinges !

The writer would make a strong plea for liberality in this matter of time, where quality, if not quantity, is concerned; for such liberality is the wisest economy.

These remarks, happily, are not called for in all cases. But a disposition to regard the work of churning as a tiresome work and one to be "got over with" as soon as possible exists in some dairies. Where such disposition does exist, it may be corrected to the great advantage of so important an investment as that of farm, cows, dairy, and labor.

Sixth. There are **Other General Advantages** in the granular system of churning, some of which need not be specially noticed, and some of which were noted in a previous connection, as, for instance, the most important ones of freeing the butter from foreign substance (thus improving eating and keeping quality), and of making it possible to salt the butter more evenly.

Granular Churning Under Difficulties. It may happen that there will be those who would desire to adopt the granular system, who yet are not supplied with the sort of churn which makes the process comparatively easy. Such are advised to make the slight investment necessary to supply the lack. Failing the ability to do that, it is yet possible to take advantage of the merit of the process. Churns with a stationery body are very ill-adapted to the process; but where there is lack of mechanical appliance, the lack must be made up by energy, experience and judgment. When the butter has advanced sufficiently, the butter-milk may be drawn off from the bottom of a churn into a strainer, or seive, that will allow the milk to pass through and leave the butter behind.

For instance, if one were using the old dash-churn, it is not convenient to draw off the butter-milk, and afterwards the water, leaving the butter behind. Yet this might be done if one were to bore a small hole in the bottom, and insert a plug. Otherwise, a suitable strainer might be placed over a vessel, and the contents be poured therein. The butter-milk would run through the strainer into the vessel, and the butter be caught and retained by the strainer itself. Brine may be poured into the churn and the butter thrown back again, into the brine, and the process repeated. There are various ways of doing this work, which will readily suggest themselves to any ingenious mind; but much the easier way is that described, of drawing off liquid from bottom of churn, and doing the whole washing in the churn.

Washing the Churn. This is one of the operations of which it may be said emphatically that there is a right way and a wrong way. In a single season a churn may be spoiled for butter-making; or one may be used for years and, so far as affects the quality of butter, be none the worse for such use. A churn should be kept in such a condition that it will always smell sweet; not sour, or mouldy, as too many churns do smell. It is very little more work to wash a churn properly than to do it badly. To wash a movable-body churn, or one without dashers, involves so little labor that there is no excuse for allowing one ever to become unfit for its proper use, unless the excuse be a lack of knowledge.

The first thing to do is to rinse out all the butter with cold water. Where one has washed the butter in the churn this is easily done. With a cup, or small dipper, *every particle* may and should be washed down and out. When all the butter has been washed out, throw enough hot water in to give the churn a good scalding. Put on the cover and give the churn a thorough agitation. Drain off the water, and leave every opening of the churn, even to the stopple-hole, free to the air, to allow a quick evaporation and drying.

Wash the cover, stopple, and other free parts by themselves, in the usual way, *and keep them separate from the churn* till again wanted. Wash the outside of the churn, and the edges of the openings, with a cloth; but *avoid using cloths inside of the churn*, unless there are fixtures inside which demand such cleaning. A churn well washed in this way—by rinsing and scalding, and dried by quick evaporation, will be perfectly clean—cleaner than if washed imperfectly by the use of cloth, soap and scrubbing.

Pure Water. Water! Wonderfully beautiful and perfect thing, as necessary to our life as the bread of wheat or the air of heaven, and given by the same all-wise, bountiful Goodness! Yet in this Christian nineteenth century, men are content to draw their supply from wells contaminated with filth; and some even are mad enough to adulterate this fluid-food of all nature with that which poisons very life!

Do the readers of this MANUAL need to be told that the water which is to be used as food for man needs to be pure? Water used to wash butter is so used; for the butter is caused to give up, as it were, its natural liquid, and to drink up a portion of the liquid in which it is washed—water—which liquid becomes henceforth a component part of the butter itself.

If there can be any valid objection to the system of water-washing of butter, it will be the possibility of the water which is used being impure. It were better than to use such water that the butter be allowed to retain what butter-milk may not be drained and pressed out of it. Or, if the cream churned were faulty by reason of age, or otherwise, it were better to wash the butter with fresh-skimmed milk than with impure water.

The defects of water sometimes may be remedied. Heating stands high as a means of purifying water. After thorough heating, remove the water and cool it in a pure atmosphere. It is so little work to strain water and brine that it should be done whenever there is the least sediment or dirt in either.

Time in Churning. Generally speaking, in butter-making there is merit in quick work; but the rule of despatch which prevails among many butter-makers ought to be modified in churning. It is simply impossible to make a fine quality of butter if one hurries the churning, and the butter-maker who aims at quality will find the expenditure of time one of highest economy.

The bringing of the butter may be hurried, either by a high temperature, or by threshing the cream as in a mill; but it should not be done. The washing of the butter and the gathering of it may be hurried by not stopping the churn early, and not cooling the butter to prevent its gathering into large masses; but it should not be done. The salting may be hurried by not taking time to pulverize the salt, to mix it in the butter evenly, and to allow it slowly to dissolve in the butter, before the butter is subjected to the hard pressure of working or packing; but it should not be done. The possible gain in time at the best is but a few minutes, and no butter-maker can afford to save so little time at so much sacrifice of quality.

Churning.—How Frequent. It is impossible to give a rule here that will apply to all circumstances. It is safe to say that any mistake in frequency of churning is on only one side; no one churns too often. There are butter-makers who have succeeded in making good butter by churning only thrice in two weeks; but it would be better to churn twice weekly; and still better, where the dairy is large enough, to churn every two days, or daily. Churning only once a week is out of the question. If the dairy be too small to allow of frequent churnings, it would be better than delaying the churning to churn often and keep the butter in granular form in brine, to be salted and packed when enough has been accumulated.

Quick Churning. The time has been when it was thought a merit to eat fast. The rebuke that Abernethy gave to the Honorable Alden Gobble, Secretary of the American Legation at the Court of St. James, is, perhaps, needed by many who believe in economy to save time in eating. Gobble was a dyspeptic. Abernethy told him he would soon get rid of his dyspepsia, for in the company he was now thrown he would have to eat like a Christian. Upon being contradicted, the old eccentric, aroused, gave his opinion with a characteristic roughness: 'I never saw a Yankee that didn't bolt his food whole, like a boa-constrictor. How can you expect to digest food that you never take the trouble to dissect nor time to masticate? It's no wonder you lose your teeth for you never use them; nor your digestion, for you overload it; nor your saliva, for you expend it upon the carpets. You Yankees load your stomachs as a Devonshire man does his cart—as fast as he can pitch it in with a fork, and as full as it can hold, and drive off. Then you complain that such a load is too heavy for you!'

And so it is with churning. It was once thought an object to churn fast; but that time, too, is gone by. True, there are farmers yet who need a little advice from some agricultural Dr. Abernethy. On looking at a churn their first enquiry will be: 'How long does it take to bring the butter?' But they are few. The days of three-minute churning, by thrashing the cream, have gone the way of five-minute dining, by bolting the food. The best dairymen now will have nothing to do with a churn that is constructed mainly with a view to *quick* work. They do not appreciate the ingenuity of giving them mechanical appliances that will hasten the operation of churning at the expense of *quality* of product. What they better appreciate now is something simple as possible in construction, and constructed mainly with a view to do *good* work. On the other hand they require that a churn do its work in a reasonable time, as now understood, and that what it loses in the once supposed merit of *speedy* churning, be made up by the always undoubted merit of *easy* churning.

It is said that in Orange County, Vermont, whose choice butter is well known, the farmers especially favor slow churning, and will try perhaps as hard to have the butter not "come" before thirty to fifty minutes, as some farmers, whose success is doubtful, try to bring the butter in fifteen to twenty-five minutes. One thing at least in this regard is sure; butter is no better for quick churning. Then if quick churning is not to improve the quality of the butter, it can have but one other object—to have the work of churning sooner done. If the churn works hard there may be some reason for hurrying it through, but if it works easy, and requires but little strength, the question of a few minutes gain in time ceases to be of much account, especially *when the quality of the butter* made is *affected by the length of time.*

Now churns are constructed upon either one of two principles: first, to churn as quickly as possible; second, to churn as easily as possible. The first usually gains time at the expense of power, and thus, the churning being hard work, makes speed an object. The second makes the work so easy and agreeable, that it may be longer or shorter and make little difference to the worker, because the work is not so tiresome. This is the main difference between the two kinds of churn, although, of course, different methods of construction may combine in varying degrees the several objects sought to be secured. From our point of view, preference will be given, other things being equal, to the easiest working churn that can be had.

Of the churns of this principle of construction, we should make choice of that one whose general construction does best for both economy of time and adaptability to result. Then churning slowly or quickly the work would be agreeable; or it could be done, when necessary, by the weaker available help; and always with best results as to quality.

"All the quick operating churns are dangerous to use, and I would advise the members of this Convention, when they find a man who has a churn warranted to bring butter in five minutes, to give him a wide berth. Ordinarily, it will spoil the butter in *two-and-a-half minutes.* It is ruined before you get it half churned."—*Lewis*, 1883.

Mr. Flint quotes the practice of a successful New York dairyman, who churns from one hour to one and a half. This in a book published twenty years since. Even at that time, he remarks, the time of churning is by no means an unimportant matter. Various contrivances have been made to shorten this operation; but the opinions of the best and most successful dairymen concur that it cannot be too much hastened without injury to the fine quality and consistency of the butter.

Says Prof. Miller (1872): "One often hears of churns in which it is claimed that butter will come in three minutes. I have yet to be convinced that good butter may be got from the cream in that time. That cream can be churned into butter in three minutes I am aware, and although the butter may be tolerable for present use, I have never been able to get a good keepable article when the churning was done in such a short space of time."

Prof. Johnson, of Yale College (1868), said: 'When butter has to come in a few minutes by violent agitation, as in the trial for repute of quick work in cases of trials of new churns, there is churned instead of good butter in dense and large clumps, a doughy mass, consisting of little balls of fat mixed with buttermilk and cream, and full of air bubbles, which no skill in working can convert into good butter. While it is true that violent churning will produce a greater weight of so-called butter, it is demonstrated by chemical analysis that the milk or cream thus treated does not yield so much of its fat as is obtained by slower and gentler agitation. The greatest weight of product is due to the admixture of buttermilk which is retained in the spongy mass.'

The Orange County butter-makers say that the time should be from forty-five minutes to one hour. Prof. Johnson says half an hour at least is considered essential for churning, when the volume of cream is considerable; and an hour, or even more, is not thought too long.

PRESSING and Salting. Under the head of granular churning the operation once known as "butter-working," and that of salting has been explained as it ought to be carried out. For the benefit of any who are not yet prepared to adopt the more advanced process at once, the next better method will now be taken up.

Pressing is the word to use to express the process that takes the place of the old method called "working," or kneading. *Working* is the proper term to express the whole process of manipulating the butter after it leaves the churn until it is ready for packing. *Kneading* expresses the old process known as "working," and it expresses what in the light of advanced knowledge has been called "over-working." Kneading is the word used in bread-making. In bread-making, kneading is a very necessary work; in butter-making, kneading is to be carefully avoided. Salting is a part of the process of pressing.

Pressing and Salting Separately. It has been a common practice to press all the water from the butter, and afterwards to work in the salt. This practice has nothing to commend it and is referred to only to suggest that it be discontinued where in vogue. It requires more working of the butter, and at a time when the butter is more or less dry, or when it is most affected by the strokes of the power used. If the salt itself be dry it makes matters worse; the sharp corners of the salt crystals cannot but have the effect of cutting the grain of the butter.

Pressing and Salting Simultaneously. The better plan is to make each stroke serve a double purpose; *i.e.*, to eliminate the water, and incorporate or evenly mix in the salt—giving the butter its solidity and compactness. In this case if the butter when removed from the churn is comparatively dry, it is as well to throw a quart or two of water on the butter in the worker. The salt may now be spread on the butter by *sifting it through a fine sieve*, so as to put it in as evenly as possible.

Let the butter now be subjected to the most direct pressure possible. Avoid any rubbing, grinding or sliding motion. Let every stroke be such as to do the least injury to the grain and to tell the best in working out the water and mixing in the salt. When the water has been pressed out, and the butter is of the right consistency, the salt should be so thoroughly incorporated that the pressing may be discontinued. Make use of the help of a sponge or cloth. It does not require greater skill nor make the work harder, while it will be likely to save the grain. When water is observed standing on the butter, while the butter is being pressed, the sponge or cloth applied to the water will absorb it and save so much pressing. Do not work out too much brine. The butter should be neither too dry nor too spongy.

Immediate vs. Delayed Pressing. There is some diversity of opinion among dairy authorities on this question. One practice is to press and salt at *a single working*, This plan has the advantage of doing up the work early. The other practice is to incorporate the salt evenly, with as little working as possible, and then set the butter away for two, six or even twelve hours, and then re-pressing before packing.

There is some advantage in delay, in that the salt has time to dissolve and do its work before the pressing is all done. There is also some risk of the butter being left too long and getting into a hardened or fixed condition, from which it ought not to be disturbed. On the whole, the writer would recommend that if there be any delay it be very short—say two or three hours only.

The Object of Pressing Butter is to free the butter from water, or butter-milk, to give the butter a more solid consistency, and to mix the salt in evenly.

Butter is sometimes re-pressed, for the purpose of thoroughly mixing different lots, and giving the whole a more uniform character and color. This object of pressing is mainly confined to store or market operations. Different small lots of butter are bought from small dairies, they are assorted as nearly as possible, and then pressed enough to give a uniform appearance when packed. This system is not to be commended; but when stores do buy and pack butter, it would be well if they were provided with a good butter-press, and if the plan were adopted of assorting, re-pressing and grading the butter, that it might be sold on its merits.

Of the **Points** in **Pressing Butter**, the first is that there should be applied the force of pressure, with **Least Possible Friction**, or without grinding. The force should be applied as carefully and direct as possible, and no more force or pressure should be applied than is absolutely necessary.

Butter should be worked, or manipulated, as little as possible. In getting out the water and mixing in the salt, which may be done at one and the same time, the butter may be pressed to its proper solidity or compactness. The butter-maker must take advantage of every means of saving any unnecessary strokes of a lever upon the butter. A cloth or a sponge may be used to press upon the butter lightly and absorb the liquid; especially at the end of the process must there be no unnecessary pressure. While there is water in the butter, the butter bears the pressure comparatively well, without affecting the grain. When the butter becomes freed from water, and solid, all pressure tends the more to its injury.

No Hand-Contact. The hands ought not to be allowed to come into contact with butter at all, especially in the way of pressing it. Not only does the touch of the hand by its heat injure the grain, but it is likely to impart a taint. The hand touch is objectionable even in health; it is more objectionable in ill-health. In health or otherwise there are emanations from the pores of the skin that should be kept away from so sensitive a thing as butter.

All hands are not equally objectionable, and the bad effects of hand-contact may be measurably avoided by care and skill in the way of preparing the hands; but it is much easier and better to avoid all necessity for hand-working. For this reason, mechanical aid is necessary, even as it is necessary in churning. For a small quantity of butter, a wooden bowl and a ladle are enough. For a larger quantity one will need a suitable butter-press, or "butter-worker."

The best material to bring into close contact with butter is something that is a poor conductor of heat, that can impart no taste, and that can be scalded and cleansed easily and thoroughly. Wood, sponge, cloth, etc., meet these requirements.

One plan that has been practiced with much satisfaction is to place on the butter-worker a muslin cloth wet with brine. If the granular butter placed thereon has not yet been salted, sift on the salt, and stir it in with the least handling possible. Press all together and put in a tub and leave a few hours—long enough for salt to dissolve. Spread this muslin cloth over the worker again, as before, and press carefully to get out the brine, and make the butter solid. The use of a ladle may be avoided by seizing the corner of the cloth and turning the whole mass at once.

The Temperature. The range of temperature suitable for pressing butter is very limited. If too high, the butter becomes soft and greasy; if too low, the butter presses with difficulty and the grain suffers. From 55° to 58° would be a safe range. A little experience will enable one to know if the butter is at the right temperature for pressing. To raise or lower the temperature, let the butter stand on the press in a colder or warmer atmosphere, as the case may require.

Object of Salting Butter. There are two main objects in salting butter: *First*, to *satisfy the demand of the consumer*. One who wants salted butter will pay more for it than he will for unsalted. One who wants unsalted butter will perhaps not buy salted butter at any price. One who wants butter salted only to a certain degree, is dissatisfied with butter containing an excess. Unless there be some other cogent reason to lead one to a contrary course, it is the wisest policy for every producer to consult the taste of the consumer.

In the matter of butter-making, there is nothing to conflict with this policy. There is only one other main object in salting butter: namely, to *make it keep.* Fortunately, butter may be made in such a manner that it will be very little dependent upon salt for its keeping quality. This makes it possible for the butter-maker to give first place to the important object of satisfying the buyer.

To what extent, however, butter is independent of salt for its keeping quality depends wholly *on its make.* The preservative effect of salt in butter is not upon the butter itself, but upon the foreign matter which butter contains. If butter contains much excess of foreign matter, much salt will be required to give the butter keeping-quality. If, on the other hand, butter contain but little of foreign matter, little salt is required to make the butter keep. It should, then, be the object of the maker to *provide against any need of over-salting*, by *making salt less necessary*, or by getting rid of as much as possible of the foreign matter in the butter. This affords a means that may be availed of by every butter-maker—of consulting the taste of the consumer in regard to salt. Advice to do this is the best advice that can be given.

There is a minor object in the use of salt in butter-making. It is difficult, in washing butter, even when it is in a granular form, to completely take from the butter the butter-milk and what the butter-milk contains. Salt serves an excellent purpose here, being used as brine in the manner already explained.

How Much Salt to Use. This should depend upon the market. In some countries, there is a large consumption of butter *wholly unsalted.* Such a demand is a profitable one. The supplying of unsalted butter means an increased consumption, better prices, quicker markets. The general taste may be gradually educated up to the point of preference for unsalted, or, at least, lightly-salted butter.

It will be in the interest of the butter-maker to help to educate buyers to this point. It will be a safe rule, then, for one if he is at all in doubt as to the quantity of salt which he should use, to lean to *the side of under-salting.* The butter will have at least this advantage: the fine flavor will be more noticeable, not being hidden by the salt. In Europe, where commercial houses buy up butter to be packed by themselves, they insist upon its being under-salted, the reason being that they are *not able to judge the flavor properly if full-salted!* When packing for shipment abroad, the additional quantity of salt required by the market is added at the packing-house. The only exception to the rule given that may be conceived is where the flavor of one's butter is something that would be better hidden, or replaced, by the taste due to the excess of salt!

The quantity of salt then, will depend upon the market. As a general rule, for the quantity required to remain in the butter, one-fourth to three-fourths of an ounce to the pound will be enough for a quick market, and one-half to three-fourths of an ounce when butter is intended for export. If butter has been washed in granular form, this quantity will be amply sufficient, and it will allow any excellent flavor the butter may possess to speak for itself.

Where butter has been pressed before salting, or, in other words, in dry salting, nearly all the salt put into it will be retained. It may in such case be weighed with considerable exactness.

In *water*-washed butter, probably from 25 to 50 per cent. of the salt will work out, so that if one and one-half ounces be added, it will leave from three-fourths of an ounce to one ounce in the butter. In *brine*-washed butter, there is less loss. Nothing but experience will be perfectly satisfactory.

What Salt to Use. Use only the best. The cost of salt is so light a proportion of the value of the butter that if a first-class quality can be procured, the price should not be considered.

Salt for butter should be pure, even-grained, thoroughly and easily soluble, dry, clean, white, and in shape preferably flat rather than cube-shaped. Coarse, hard-grained, slow-dissolving, badly put-up, cheap salt should be avoided. In fact the very finest brand obtainable, manufactured specially for butter, should be procured.

The salt required for brine does not absolutely require all the qualities demanded by the dry salt intended for directly salting the butter. It is required that it does not contain soluble impurities which would not be removed by straining the brine.

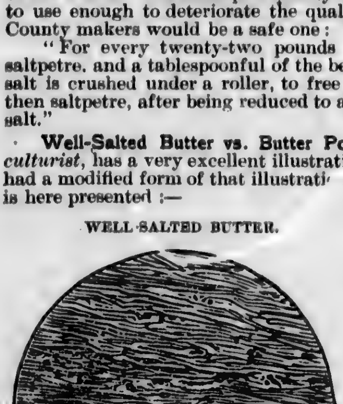
Test of Salt. The most simple test of impurity, is the effect upon the salt of damp weather. If the salt gather dampness it is impure; if it remain dry it is likely to be satisfactory. A trial may be made by exposing a layer of salt on a plate to the damp atmosphere of the night.

Saltpetre and Sugar in Butter. Many excellent butter-makers claim that the addition of saltpetre and sugar will add to the keeping quality of butter. This agrees with the experience of the writer. The antiseptic quality of both articles is undoubted. Care must be taken not to use enough to deteriorate the quality. The rule in practice among the New York Orange County makers would be a safe one:

"For every twenty-two pounds of butter, sixteen ounces of salt, one teaspoonful of saltpetre, and a tablespoonful of the best powdered white sugar. In preparing this mixture, salt is crushed under a roller, to free it from all lumps; it is then run through a seive, and then saltpetre, after being reduced to a powder, is evenly mingled with the sugar through the salt."

Well-Salted Butter vs. Butter Poorly Salted. Henry Stewart, in the *American Agriculturist*, has a very excellent illustration of the difference in butters due to salting. We have had a modified form of that illustration engraved specially for this MANUAL, and the engraving is here presented:—

WELL-SALTED BUTTER.



POORLY SALTED BUTTER.

The upper half of the sphere shows the appearance under a microscope, of a sample of well-salted butter. In the under half is shown a sample in which salt of a poor quality has been used; and this has not been evenly mixed in the butter.

"In the first sample, the salt has been entirely dissolved; not a single crystal remains visible, although the magnifying power used was equal to five hundred diameters! The complete solution of the salt, and the thorough mixture of the brine in the butter, and the very perfect working of it, give to the butter a firm, dry and waxy consistency, and an even quality and flavor, which are the characteristics of good quality, and which go to preserve it for a long time.

"The other sample shows a large quantity of salt undissolved; the peculiar form of the salt crystals is readily perceived. Of course this unevenness injures the quality, and causes the butter to deteriorate very rapidly, because a large portion of it is not affected by the salt, which remains undissolved, and of course cannot exercise its desired antiseptic action. Moreover, the salt is impure, as is shown by the arrow-head crystals, which are evidently sulphate of lime, a common impurity in a poor quality of salt, and which gives a bitter taste to the butter, and causes white spots to appear in it."

A study of the above will show the great importance of salting butter properly. "Good butter is wholly spoiled by improper salting, while butter that is not good, by careful salting may be improved and kept from getting worse. The first requisite is good salt; the next is to mix the salt thoroughly with the butter."

The dairyman may learn here the need there is to select the purest and finest salt in the market, regardless of price; and to evenly incorporate that salt in the butter even at some cost in time and pains.

PACKING. There are reasons more than one why butter should be packed in the very best manner possible. *First.* At packing there remains little more to do; nearly all the required outlay of capital, time, and labor has been made, and one is at the point of drawing the full return for the whole investment. Now, this expected return depends not only upon the character of the very considerable outlay already made, but almost as much upon the character of the very little outlay yet necessary to be made. This is a cogent reason for doing this last work well.

Second. Bad packing *spoils the good work already done.* The finest butter made, if badly packed, will not sell for fine butter. The reason is plain. A single fault in any article is just so much proof of faultiness; and the fact of visible defect is suggestive and presumptive of other imperfection.

This would be true of any fault found anywhere, or at any time; but, as applied to butter, the truth has more meaning than it has in usual application. How true it is that a single hair, or even a stray thread with a striking resemblance to a hair, which by some untoward accident has found its way into butter that in all other respects were faultless, will create distrust in spite of all other clear evidence of real merit. This is particularly true of a fault that appears at one's first look at anything. It makes much difference whether the ball of butter in which the hair has been found is the first one of a new supply, or a chance ball of a make to which one is long accustomed, and which has gained one's confidence. When the first thing to greet one's eye is something faulty, it is likely, with most people, to arouse a prejudice against the whole. It is very natural, too, to suppose that anyone who would be painstaking and neat all through a somewhat lengthy process, would not be careless and slovenly with the last short finishing touches. One is likely to assume that a discreditable finish is a pretty sure indication of more or less bad management all along. On the other hand, it is very natural to fancy that a fine outside polish on the surface is an indication of good stuff within.

Apply this existing tendency to our butter. The very first look that the butter-buyer gets is at the *package.* Before the quality of the butter has been observed at all, an impression has been created, for or against, by the mere appearance presented by the thing in which the butter is enveloped! This appearance may be enough to create a bias in favor of the butter, or a prejudice against. No one who has closely observed the effect of little influences upon butter-buyers, or even upon judges of butter at fairs, can fail to appreciate this as a strong factor.

It would be good policy for even a poor butter-maker to take advantage of this fact; it would be folly on the part of the good butter-maker not to take the fullest possible advantage of this fact.

Third. The third reason why packing should be well done is not less strong than the foregoing. Upon the packing, as upon the make, depends the keeping-quality of butter. It is only by being well packed that butter will hold for a necessary length of time whatever good qualities it may possess. It is remarkably easy to spoil the best of butter by bad packing. Butter is something that is subject to constant change. In only one way can that change be favorable to the butter, and that is a possible improvement in some cases by ripening. All other change is against it; and this improvement by ripening must proceed slowly, or cause the butter to be short-lived. The extent of that undesirable change is affected by whatever comes into contact with the butter. Some things, for instance a nut or an apple, are provided in themselves with some protection against the untoward influences surrounding them. Butter, an artificial product, in some respects more easily affected—as for instance by temperature—is not so provided, and is dependent wholly upon an artificial provision—in other words upon the *packing.*

This is an important consideration. It will be found that the successful butter-makers provide against injury to their well-made butter, by giving it the artificial protection of some kind of covering. The careless butter-maker leaves it unprotected against the rough handling which it is sure to get.

A moment's thought will show the butter-maker the need of seeing that butter is provided with protection against handling, not only till it gets into the dealer's hands but *till it reaches the consumer.* As the trade is now constituted in most places, the only hope for butter holding its own during its stay in the hands of the dealer, is the provision that has been made for it by the wise forethought of the one who made it what it is.

It is then a matter of self-interest for every butter-maker to take pains to provide such covering and protection for butter that will ensure its safe arrival into the hands of the consumer.

Perhaps it may seem that too much is being made of these points; but surely the fact that they are practically disregarded by thousands of intelligent butter-makers, to the extent of individual and national loss, ought to justify the emphasis given to a factor of the highest importance in a real national problem—how to improve the butter trade.

The experience of the writer might supply numerous striking instances of the effect of the packing upon the price of the butter. In one case two lots of butter were submitted to inspection in a city grocery. One lot was rated prime, and the other as second-rate. It was then learned that the two lots of butter were brought in at the same time, and were of identical make. The whole difference lay in the packing. One lot was packed in a neat, new butter-tub. The tub was filled to the proper height to allow the cover to fit, and the appearance of the top of the butter, as well as that of the package, was pleasing. The color, taste, grain and flavor were all good.

The other lot was packed in a second-hand factory pail that looked as if it had seen veteran service, it may have been in butter-carrying, or at something else. The pail not having any cover, the butter had been packed on in the shape of a dome above the top. This surface had been smoothed down till it had a greasy, dirty look, that made quite a contrast with the surface of the other package. Around the edge, wherever it touched the pail, the butter had acquired a strong taste from the package itself. The *tryer* alone gave any indication of the common origin of the twin samples, made so dissimilar by their dress.

The owner of the butter, who was an intelligent, sensible dairywoman, and an excellent butter-maker, acquiesced in the judgment that discounted the value of one sample. She realized, too, that the deduction would have been greater had it not been that the discounted package was in so good company. And she thought the loss a small cost for a good lesson.

It is stated that an attempt was made to export Irish butter in tin packages, but the trade seemed to be monopolized by foreign countries. The attempt failed for a time. It was not because the Irish butter was faulty, for it was said to have a "splendid quality and great keeping qualities." Irish packers improved their system of packing, exhibited at a great International Exhibition; the result was an immediate and marked increase in the export trade.

There are **Various Systems of Packing**, and the one to be adopted depends upon the market for which the butter is intended. There may be said generally to be two kinds of market—a *slow market* and a *quick market*. In one respect, butter, for either market, should be packed alike—**Good Packing** ought to be a characteristic of butter intended for *any* market.

It is a mistake to suppose that butter, because it is going at once out of one's hands, and is likely to be consumed in a short time, is going to carry itself along in a happy-go-lucky way, and to stand the journey without harm. The few days that must usually elapse between the dairy and the consumer is quite enough to spoil any butter if it be not fitted by the protection of package to withstand the influences adverse to its keeping. This is even more true of butter made for immediate consumption, that is usually less salted, and has that more delicate flavor which gives it the quality expected of fresh butter. Butter for either market, then, must be packed *well*. The difference that may be allowed is in the *manner* of packing.

Butter for a **Quick Market**, or for immediate use, as a rule, is put up in small parcels, and in such shape that it will present an attractive appearance for the table when wanted. The simplest form of putting up small parcels is that of rolls, blocks, balls, patts or prints.

All these may be designated in a general way as **Butter in Table Shapes.** For this class of butter it is an excellent plan, when convenient, to pack in **Return Packages.**

These are provided with some convenient way of putting up a certain number of pounds, and keeping each parcel of butter perfectly separate from the rest; and constructed with a view to giving the butter the most perfect protection from accident of handling, air contact, or temperature.

A simple form of such package is a box in which are contained well-fitting, shallow trays, the latter being divided into compartments large enough to hold a single parcel of butter. The whole is made of wood.

Some modification of this plan is advantageous even when one has so close and quick a market as the village store.

A farmer, living a few miles out of the town in which these lines are penned, determined to deliver his butter to the local trader on a certain day each week, and in an improved shape. He constructed a plain box, with shallow wooden trays just large enough to fit in the box; and enough of them to fill the box and allow a loose cover to fit down upon them, to hold them in place. The trays, of course, were all of one size, and the dimensions were such that the rows of balls fitted in perfectly without pressing each other out of shape. The trays were plain boxes and not divided into compartments. The size of the whole package was suited to the output of the dairy, and in shape, conveniently oblong. The box was brought to the store filled, and left till emptied, in the course of trade, to be taken home the next trip. What was the result of a little calculation, and the expenditure of a few hours' in constructing boxes?

Quickly appreciating the advantages of that system of packing, the dealer offered the farmer 15 cents per pound, the ruling price being 13 cents per pound. This was only two cents over the ruling price; but that small advance was a little *more than* 15 *per cent. advance!*

Moreover, the demand for this butter, at a higher price than then current, was greater than the farmer could supply. This was a result especially gratifying at a time when butter was almost a drug in the market, as will be understood by the exceptionally low prices that were ruling. It was profitable to the dealer, for it increased his trade; customers, to be sure of a supply, began to send in their orders ahead—faster than they could be filled.

This butter was necessarily good butter, but it was not of better quality than was a great deal of the butter brought in by other farmers. The whole advantage lay in the packing. The old system had been to bring the butter, rough-and-tumble, in some stray basket, or chance pail, possibly covered with a cloth. The bruised, out-of-shape prints had to be removed, and they were laid away in some much-used receptacle, probably to be mixed up with a medley of all sorts and sizes of butter parcels. All this handling, mixing, and damaging association, was avoided by the new plan, which left the butter comparatively undisturbed in its one abiding-place from the hands of the dairywoman to the plate of the consumer.

It is needless to say that a like departure soon found imitators, which was desirable, for it led to a more satisfactory general supply, increased demand and better prices.

Any dairyman is able either to construct a suitable box for himself, or to devise one and order it made at the nearest wood-working shop.

There are many dairymen who are under contract to supply special customers by a direct delivery, from week to week, the year round. The system of return packages may be adopted also by such as these, to a mutual advantage.

This system has been found satisfactory, too, in supplying distant customers. The empty boxes are returned free, or at a low price, by special arrangement with the transportation companies.

There are already in the market various styles of return packages, and such packages ought to become still more common.

Butter in shapes will stand better and handle better if each parcel be protected with a cloth. Paraffine paper, prepared especially therefor, has been used with success, but common paper is to be avoided. White muslin is suitable. Wash it first in hot water to free it from any stiffening, and then dip in brine and wrap closely around the roll or block of butter.

Take a little pains at the very beginning to find the right shape to cut the cloth, to have it fit the best and present the neatest appearance. Having adopted a certain style of wrapping, follow it uniformly until a better way is found.

Mr. Cheever, the practical butter-maker who edits the *New England Farmer*, gives his method of supplying the Boston market, as follows: The butter is printed in quarter-pound cakes, by hand labor. It is then folded in new bleached cotton wrappers, and packed for market, four layers deep, *with cloth between*, in round wooden boxes holding 14 pounds each. These boxes are enclosed in strong shipping-cases; and, in summer, broken ice is used between the smaller boxes while in transit. Mr. Cheever uses ice for no other purpose than shipping the butter.

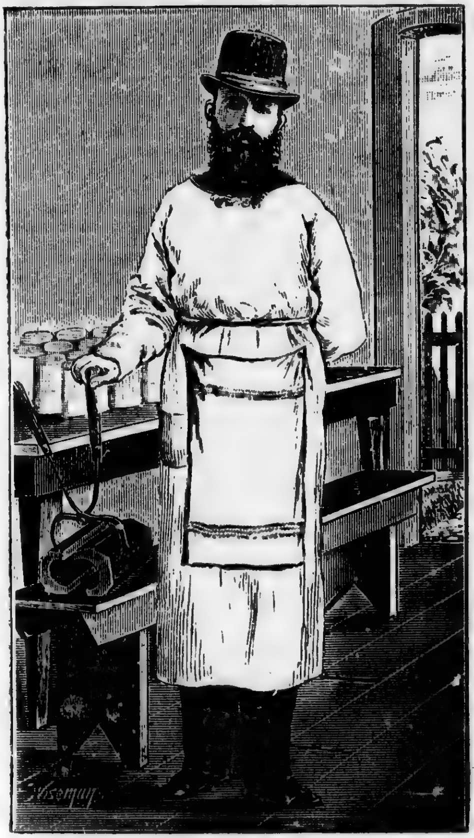
Butter in quantities is sent from France to England in rough pine boxes holding two dozen pounds each. The butter is made into two-pound rolls, is wrapped in muslin—called mull muslin, with an outside covering of clean white paper. The butter arrives in London fresh, perfectly clean and unbruised.

The boxes measure 14 inches in length, by 10½ inches in width, and 6½ inches in depth. The butter is placed on end; in 3 rows, 4 rolls in a row. Thus 3½ inches square are allowed for each roll; the rolls would, therefore, be each about 3¼ inches in diameter, and 6¼ inches long.

There are other ways of putting up these rolls, thus described:—"The butter is first made with all possible care, and is rolled into small cylindrical shapes, four or five inches long and not more than two inches in diameter. These rolls are then wrapped in muslin cloths and the ends drawn over. A large crock is next nearly filled with strong brine, and these rolls of butter are immersed in this solution. A weight is put into the crock to keep the rolls from floating. The butter as wanted can be secured without disturbing the mass, as is necessary when packed into tubs, and it is then always fresh. It will not absorb salt from the brine, for the reason that salt and butter never make alliances; and as the butter will not take up additional moisture, there can be no possibility of it taking up extra salt. Being immersed in the brine it is uninfluenced by the air."

This style of roll has much to recommend it. It is compact, plain and neat, and attractive in appearance. It may be made in almost any size from a diameter of 1½ inches to 3 inches, and any convenient length. The housekeeper finds it a good shape for her purpose, for she can slice it off in a thickness to suit her table. This style of roll is suitable, too, for a close-at-hand market, or for shipment; for immediate consumption, or for keeping in brine.

These rolls are more or less common in many localities, for instance, in France and in California. Dairymen who have not already adopted something equally good, or better, are recommended to try these cylindrical rolls.



"PACKING."—MAKING ROLLS.

(A Convenient Dairy Apron—New.)

The above is an illustration of a convenient and inexpensive BUTTER MOULD which is used for making these rolls; also a new DAIRY APRON (both of which will be described under the head of UTENSILS and SUPPLIES).

Another method is that of the Darlingtons, of the United States, of putting up their "gilt-edged" butter. This butter is put up in half-pound patts. When hard and firm, each package is wrapped in a white cloth, and these patts are packed in upright zinc cans which hold 8 patts, or 4 pounds. The cans are covered with a lid, and placed in a wooden package about the size of a pail. Ice is then placed between the zinc cans, and a water-tight lid is fastened on the pail. These packages are shipped to Philadelphia, and from there to all parts of the States, from Maine to Florida. This butter sells for from 60 to 95 cents per pound—a price not due, of course to the packing alone, but unobtainable without good packing. This system of packing appears to have great merit; in fact, to be one of the most ready and convenient, and one of the best. It might be modified and adapted even to supplying one's local trade.

Harris Lewis, of New York, is one of the successful and intelligent dairymen who have helped to disseminate knowledge of improved methods. Mr. Lewis describes his way of putting up butter for a near-by market.—He weighs each pound, and balances the scales at 17 ounces, that there may be always a full pound when finished. The butter is pressed into a block as broad as it is thick, and twice as long as it is broad. With a wire he cuts the blocks into two pieces, leaving it in cubes of half a pound each. These are wrapped in paraffine paper, packed in boxes and shipped.

Another way of putting up butter for a quick market is in **Small Packages.** One style of these packages is a small, cheap *box*, made very thin and light, square in shape, with a sliding cover. These boxes may be lined with suitable white paper, cut in strips and merely laid in. The width of the strips of paper should be the same as that of the box, and the length four times the width. Two strips only will be required for each box. For instance, for a box 5 inches square inside, the strips are 5 inches wide and 20 inches long. Lay in one strip in a way to cover the bottom and two opposite sides, leaving the end or ends out to be laid over the top after the butter is packed. Lay in the second strip in like manner, crossing the first strip at right angles at the bottom.

So doing is to line the sides with single thickness, and the bottom and top double. The butter is pressed in solid, with a packer conveniently shaped something like a pestle. The ends of the paper are folded over, and the cover slid on. These small boxes are packed in one large box, or case, made of a convenient size and style for shipping.

These boxes should be made in somewhat considerable quantities in order to be cheap. A good size is one to contain 5 lbs. City markets have been supplied from a distance of several hundred miles by this style of package.

One of the very simplest and best methods of supplying butter for quick consumption is in small pails,—5, 10 or 20 pounds each. The consumer in that way may buy a conveniently small quantity at a time, and the butter may retain its fine quality to the last. The pail is not returnable, but it is worth its cost for some other purpose.

Or, one may use cheap veneer pails, or boxes. These are very cheap, their cost being not over two cents per pound of butter. The cost is more than repaid by the better satisfaction to buyer, who is more than willing to pay the extra price.

The package known as the **Welch Tub** is adapted also for a quick market. The Welch tub is the ordinary butter tub, straight staves and flaring, larger at top than at bottom. The size of such a tub, holding 20 pounds, would be: breadth across top, 9¾ inches; across bottom, 7½ inches; and depth inside, 9 inches. A hooped cover is made to fit closely the top.

The cover of the Welch tub is fastened down by four tin strips. One end of the strip is first nailed on the cover, the other end being held towards the centre of the cover, or in the opposite direction from that which it is intended to remain. The strip is now bent over so that the nail is covered; it is then hammered down closely and, while held tight, it is tacked to the sides of the tub. It is always desirable to have clean, new strips and to tack the cover down neatly and tightly.

When one has put in these tubs good butter, and packed it well, it is no waste to enclose each tub in a well-fitting bag, closed at the top by a string run through an open seam, after the manner of tieing up ordinary work-bags. The cost is slight, and the tub is well protected, and clean when received.

There is another form of package, called the **Return Pail,** which differs slightly from the Welch tub. Two of the staves rise higher than the rest and form ears, by which a bar is held across the top. The cover fits closely and is wedged down tight by the cross-bar. These pails or tubs, when well made and used for return packages, are preferably varnished on the outside.

Such tubs would have much more to recommend them as *return* packages, if only they were rendered impervious on the *inner* side to water and air. Until that has been accomplished they will be faulty; for in general practice one use of such a tub is enough.

The local circumstances will suggest to the intelligent dairyman the plan best suited to his needs.

Butter for a **slow market** is necessarily put up in larger packages. The most common is the Welch tub, and the preference of the butter trade seems to pronounce it the best. The Welch tubs are made to hold 30, 50 and 70 pounds each.

These tubs are sometimes made by hand, but now more generally by machinery in factories. The best machine tubs are well made, very neat in appearance, and quite cheap.

Some of the machine tubs are faulty, in that they leak the brine. This is perhaps due to cutting across the grain in sawing out the staves, and may be avoided by splitting the blocks, and so following the grain in sawing. Or, it may be due to the use of staves not well seasoned. Some manufacturers appear to have succeeded in making a good tub; and what one manufacturer has done, others ought to be able to do. Nothing but a good tub should be tolerated, and the imperative demands of dairymen ought to make the manufacture of poor tubs unprofitable.

The "return pail" form of the Welch tub, already described, is also suited admirably for a slow market, though not for shipment abroad. Good butter, well packed in these pails will keep a long time, when properly stored.

The **One Hundred Pound Firkin** is simply a complete barrel, headed in the usual way. It is difficult to conceive a better form to pack large quantities for long shipment, having in view long keeping and economic handling. Owing, perhaps, to the large quantity, and possibly to dishonest practices which could not easily be detected, this package is not always so popular as it would seem to deserve to be.

Preliminary to packing is the **Preparation of the Tub.** What is required in a tub is that it will not leak, that the pores of the wood be air-tight and that the wood neither soak up the butter nor impart a taste to it, nor otherwise injure the flavor, and that any spores or germs in the wood, which might cause mold, be destroyed by heat.

Wood, in its natural state, contains sap and gummy matter. This gum would be useful enough in filling the pores of the wood; but in one respect it is objectionable, for when salt comes into contact with it the effect is to draw it out of the wood. This sap and gum when drawn out by the salt of the butter will impart an objectionable taste to the latter. To avoid both the leakage and the injury to butter, **Salt** is used freely to prepare the tub before packing, to draw out a portion of the gum, and then to refill the pores with itself. The filling of the pores prevents the absorption of the salt from the butter, which would leave the butter white, and quick to spoil. The usual way to accomplish all this is to soak the tubs in brine.

Various ways of brining the tubs are employed: One soaks in cold brine several days, changing the brine several times, and rinsing with cold water afterwards. Another soaks in a single brine, renewing it by adding more salt; and using the brine over and over by thus renewing its strength. A very common method is to pour in hot brine, allow it to stand for a day or two, then rinse with cold water and rub with dry salt. Another recommends adding saltpetre to the brine.

Still another method is to soak the tub with strong brine for two or three days; pour out this brine and fill with boiling hot brine, leaving this hot brine to stand for about a day. It is probable that the latter plan is the most effective. Whatever plan be adopted, scalding should not be neglected, and brining is to be strongly recommended.

It would seem wiser to use fresh brine at least with every new lot of tubs. Brine need not be wasted. All the brine used in washing and salting the butter and preparing the tub may be substituted for salt for cattle.

There are other plans of preparing tubs, by use of whey or buttermilk, by steeping in sweet hay, &c, but the brine-washing is doubtless the best of all.

Hay-water—sweet clover hay—is very frequently used, however, in sweetening dairy vessels of different kinds, of wood and tin, for handling butter and packing it. It is much employed in Irish dairies and can be usefully employed elsewhere. The hay-water is poured in quite hot.

How *not* to prepare a tub is described by a city commission merchant who speaks as if he knew something about the practices employed and their practical effect upon the trade:—

"There is a great deal of valuable produce spoiled by ignorant packing. Now, when some farmers pack butter, they often act as if afraid of the tub. They take it, and, putting a great dirty stone in it, sink it in the nearest creek, or water hole, or horse-trough for a week. Then drag it out and put the butter into the tub, when the pores of the wood are full of dirty water. This not only ruins the butter, but it spoils the tubs. The most valuable thing about a spruce tub is the gum that is in it, which prevents anything tainting the butter through it. If you soak the log the tub is made of, or the tub itself, for a long time, all this gum is washed out and lost. Now the proper way to pack a tub of butter is to take one of these nice clean spruce tubs, and fill it up full of the hot brine; let it stand like that for a day, and then put in your butter."

On the point of soaking with *hot brine* there is agreement on all sides. Before packing, the tub, while still wet, should be rubbed with fine salt.

The Operation. In packing, press the butter against the sides, keeping the surface concave, or lower in the middle. By thus keeping the center hollow, the butter will pack more solid; and one will the better avoid leaving air spaces around the sides of the tub.

Cover the top with a piece of fine muslin, from which all starch has been washed out, and which has been dipped in brine. This cloth should be cut about half an inch larger than the top of the butter. Press the excess cloth down between the outside of the butter and the inside of the tub.

Put on a layer of salt, and add water enough to make a brine, but not enough to dissolve the salt. Put on the cover and press it tight to its place.

Butter should be packed at a temperature of 60° to 55°, and kept at a temperature even lower.

There is some difference of opinion whether it is well to place a layer of salt in the bottom of the tub, or only to rub the bottom, as indicated above, with dry salt. One suggests even salting occasionally between different layers of packing, so that the butter, being in layers, may be taken out more easily.

The wishes of the butter dealers ought to be consulted in these matters in which there is a difference of opinion, or in matters of doubt.

There are, however, a few **Essential Points** about which there is no question.

First. The butter should be *solid—without air spaces.* This point has already been touched upon.

Second. The butter should be *uniform* in color and appearance *throughout the whole package.*. Several colors in a single tub will make the sale of the butter more difficult, and will lessen the price. It is better always to pack a full tub at a single packing. This can be done easily in large dairies. In small dairies it can be done by keeping the different churnings in the granular form, in a butter-holder, and packing only when enough has accumulated with which to fill a tub.

Where one cannot fill a tub at a single packing, some of the brine should be placed over the butter at each partial packing, to be poured off at the next time of packing, and a cloth wet with brine then stretched across the top of the tub, and the cover pressed down over the cloth.

An effort should be made to have the subsequent churning as near as possible of the same color. With care in these few respects the difference in appearance of the different churnings will not be so marked.

Third. Butter should be packed to permit of knowing and checking *the weight* of the butter at any time. Weigh the empty tub *just before packing*, and mark the weight legibly upon both *the tub* and *the cover.* When packed, the full weight of the filled package should be marked just before the weight of tub, and the difference noted after. A package weighing 7½ lbs., and when filled weighing 37½ lbs., would be marked thus: 37½—7½=30.

Fourth. The *name of the maker*, and the *brand* of that maker, also the *date of packing*, should be marked legibly on both the tub and the cover. The exception to the rule would be when the marker is ashamed of his goods, or has by some mischance failed to make so good an article as usual, in which case it should not carry his brand, but sell on its merits. This precaution is merely taking advantage of a good opportunity to advertise one's goods, and help buyers who may like the goods to find one out and get a new supply. To lose so good a chance of providing for future trade, in so easy and inexpensive a way as branding one's goods, is to show an utter lack of business talent.

It would be an excellent plan for every butter-maker to buy a rubber stamp with his name and brand. The date may be written on, but it would be better even to have a date stamp for each packing month of the year. A stencil plate would perhaps be less expensive than a rubber stamp, but it is less convenient.

Every reader who is a maker of good butter is assured that one of the best investments he can make is for something with which to brand his butter. If one has not chosen a trade-mark, it should be done at once, and the trade-mark always used, so as to familiarize buyer and consumer with the brand. This course is important in the interest both of the individual butter-maker and of the butter industry.

It is to be regretted that there is a risk connected with the use of a private mark on butter packages. A writer in the *American Agriculturist* claims to have seen his own pails in the New York market, re-filled with poor stuff, and sold upon the strength of the brand. This contingency should be guarded against in every possible manner. First, one should deal with commission men of known integrity; and second, one should mark the date of make plainly on all packages. Against so grievous an injury to both reputation and pocket, there should be effective legislation.

MARKETING. The object of every manufacturer is to find the best market for his goods. It is as necessary that the goods be well sold as it is that they be well made. The butter-maker is a manufacturer; and not only is it important that he know well the industrial branch of his vocation, but that he understand something of the trade side of his business. It does not follow that because the make of the goods is all that could be desired they will sell, as a matter of course, at their full value. It is no uncommon thing to see good butter selling at less than value, and poor butter selling for more than it is worth. Because of the foregoing and similar reasons, it is true that the interests of the individual butter-maker, and of the whole butter industry, demand that the trade question be discussed as a feature of scientific or profitable dairy practice.

There are a few **Special Points** to which, in this connection, our attention may be directed profitably:—

First. **Quality** is the chief merit of butter. It is as a luxury that butter has its high value —a value beyond what its nutritive character alone would warrant. Butter will continue to be a luxury only so long as its quality is high. There are few other manufactured articles where quality has so much to do with the disposal of them—in creating and sustaining a demand—as it has to do with butter.

Quality is important, in that it affects both the *sale* and the *prices* of dairy goods.

The **Sale** of butter is affected by quality *at home* and *abroad*..

(*a*) In the **Home Market** the advantage of quality is to *increase the consumption*, and consequently the demand. Butter is an article generally to be found on all tables. At most tables consumers are free to eat much or little—according to one's liking. Now, whether one will eat much or little, or any at all, will depend upon the quality of what is offered. Is it not true that a choice artice of butter is tempting to everybody, while a poor article is endurable by very few? Is it not true that inclination usually inclines to a liberal consumption of what is choice; to a moderate consumption of what is only fair; and to turn away without tasting when the quality is so poor that the senses both of sight and smell are offended? One has been a poor observer, or has had a limited range of experience, not to have noticed to what an extent the consumption is affected by the quality of the article placed upon the tables of consumers. If anything were wanting to prove this it would be found in the fact of such fancy prices being given to the gilt-edged butter, ranging from the highest-quoted market prices to one dollar per pound.

If the quality of all the butter and cheese made in Canada were the very best, it is probable that the Canadian home consumption would be at least equal to what is now consumed and exported. This statement involves a larger proportionate increased consumption of cheese than of butter; but even such increase would not make the consumption of cheese per head of population in Canada what it is in England. There are two agencies that will have an educational effect upon consumers, and so will increase home consumption. These agencies are *quality* and *low prices*; and quality surely has even more to do than low prices in creating a liking and a demand for an article that has so much the character of a luxury as has butter—or even cheese.

There is a lesson in this. Not only ought one to aim to make a choice sample of butter because that particular sample will sell easier or better; but every butter-maker ought to make the choicest article possible to encourage a *larger consumption* and the general benefits to the whole dairy industry that would follow such a result.

(*b*) In a **Foreign Market**, the main advantage of quality would be to *meet competition* successfully.

Competition is already keen, and it is becoming keener every day. There is one absolute condition of success in establishing a foreign market that will make a permanent demand for our goods and that condition is quality.

This condition is more imperative now than it was a few years ago; *first*, because competitors have improved their methods, and *second*, because artificial products have been introduced which successfully compete with inferior qualities of natural products.

The introduction of **Counterfeit Butter** has had much to do in making a great change in the market conditions affecting the demand and sale of real butter. It has even led to some improvement in methods of butter-making. It certainly has affected the chances of sale of an inferior product. Once butter would sell in a foreign market, even though it had a very indifferent quality. In the first place, before the advent of oleomargarine, the sale of the natural product at some price was more speedy. Now the latter is held longer, and delay means deterioration constantly accelerated. The poorer grades are the last sold, and they are the quickest to deteriorate. Such grades never had too much chance at the best. The introduction of a substitute of a quality that gave it preference over poor grades, took away the last poor chance that the poor grades had left.

It came about in very natural course. Inferior samples of butter that once had their little turn, began to be avoided by buyers and were at first hopefully held on to by sellers, and this state of things continuing until the sellers were glad, at any price, for any purpose, to get rid of any article, whose destiny was not the dining table, unless in a disguised form.

It is not strange that a somewhat sudden appearance of so disturbing a character as oleomargarine demoralized that end of the butter trade most easily affected—the tail-end, or the supply of *stuff* called butter—a thing whose natural good qualities of flavor had been hidden by an excess of salt; and the taste of the salt even failing to hide the rancidity which rose over and above all. The head-end of the trade was little affected. A natural objection to what was a spurious compound at its best, and an utter repugnance to that compound at its worst, led to a decided preference for the genuine article, whenever the latter had any merit of its own sufficient to make it at all likeable. Thus quality became more than ever the condition of the successful marketing of butter.

The demand of the poorest butter (unlike the condition of the butter itself) never was very sharp. It is now becoming milder than ever, and the demand for the *best* butter has always been even greater than the supply.

Few countries have advanced so far in the art of butter-making that the bulk of the butter produced has been the best grade. In this fact lies **An Opportunity** for some country to speedily **Improve the Quality** and furnish the **World's Market** with that for which it is calling, and for which it is willing to pay well.

The effect of quality on **Prices** is one that ought to carry force with all butter-makers. It is doubtful if any other article of diet has such a range of prices as butter. Indeed, there seems to be no other article that, essentially almost a pure luxury, has become so common an article of diet and so much a necessity by virtue of habit and use. So much a necessity does butter become that once accustomed to it, most families will continue to seek it, be the price what it may, so long as it be within reach of their means.

The price of butter ranges all the way from 10 cents to one dollar. While the higher-priced brands are perhaps not so much superior to *some* of the lower-priced brands as the difference in price would indicate, yet the extent of supply of the different grades virtually regulates prices, as it does in everything else. This fact is modified by the peculiar qualities of butter, in which qualities nice and delicate distinctious are justly made. Certainly, high prices are paid purely for quality, or for what is supposed to be quality. It may come, when a finer quality is more generally made, that what are called fancy prices will be lowered; but along with that effect there doubtless will be an increase in the average prices, due to the larger consumption of fine butter, moderately high-priced.

All these considerations point out emphatically that the regulator of *prices* is QUALITY, a fact strongly encouraging to an effort on the part of every butter-maker to help in every way possible to improve the whole make of butter in this important respect. If the butter trade be depressed, if the home consumption be less than it ought to be, if the exports are falling off instead of increasing, if prices be low—if, in a word, the outlook be discouraging, it may be said truly that the whole evil lies mainly in the fact that a good deal of the butter made, instead of being the choice luxury it might be, is a poor distrusted thing. If a remedy be sought, let it be looked for in the simple recipe—IMPROVE THE QUALITY.

The marketable quality of butter is judged by certain **Points**. It is difficult always to determine the *relative* importance of the different points, because they are all so important; for instance, color has absolutely no effect upon the eating quality of butter, because it does not affect the taste; yet a good color is sometimes necessary, in order to make butter salable. The lesson from this, then, is that *careful attention be given to everything that will be taken into account in grading the butter in the market.* The "**Scale of Points**" usually adopted for judging butter is necessarily somewhat arbitrary, for the reason just given; that is, the difficulty of estimating their relative importance. Naturally, different scales have been adopted, and sometimes they are misleading and unjust. The scale of points adopted at the Dominion Exhibition (1886) allows 10 points for each of five qualities.

This scale is open to criticism. For instance, why should color be made equal with either keeping-quality, flavor or texture? Color is secured with comparative ease, it adds no *real* value to food, and may be only imitation; while each of the other qualities are important intrinsic qualities, and are secured only by skilful manipulation all through the process. Again, if keeping quality be equal to flavor, in butter intended for a quick market, it must be more than equal in butter intended for a slow market. Again, heavy over-salting would be a defect to which a poor, though perhaps natural, color is not to be compared.

Doubtless, no scale of points could be devised that would not be open to similar criticism. The best that can be said is that a scale is sometimes necessary, as at exhibitions, and that time and experience will give an approximately just one. The principal merit of the evenly proportioned scale just given, is that it brings into equal prominence each quality of butter, making it necessary for *equal attention to the minor points.* The effect of this upon the butter-maker is good; and if injustice be done it will not be in the *market*, for here the buyer does not judge butter by any mechanical rule, but rather upon its *merchantable merits*, as nearly as his judgment will enable him to do this. A Standard Scale of Points is desirable. Whether or not one is practicable is an open question. The following varied scales will show how far apart we are in our ideas of what should constitute standard points :—

Scales. / *Quality.*	1. Lynch.	2. Vermont Dairymen	3. Butter Color Dealers.	4. Dominion Exhibit'n	5. Hiram Smith.	6. Sundry Authorities.
Eating Quality (or Flavor)	25	35	25	10	20	10
Keeping Quality (or Make)	15	..	20	10	..	..
Grain, or Texture	10	25	15	10	12	20
Purity, or Freedom from Caseine, etc	10	..	..	..	..	..
Salting	10	..	..	..	6	5
Solidity	10	20	10	..	..	..
Packing	10	..	..	..	6	5
Color	..	15	15	10	6	10
Appearance	..	..	..	..	..	..
Color and Appearance	10	..	..	..	..	..
Make	..	..	15	..	..	..
Make and Salting	..	..	..	10	..	..
Salt	..	5	..	..	..	..
	100	100	100	50	50	50

The scale of points in the first column is the result of an attempt by the writer to establish a Standard Scale of Points. It is too much to hope that in the above this object has been fully attained. It is enough to hope that the foregoing may form or suggest a scientific basis upon which experience in time may build what will be general acceptable.

The two essential qualities in butter-making are the eating and the keeping qualities; and everything else is practically included therein. The only object of giving points to other than those qualities is to afford an opportunity of making an estimate in detail.

Sometimes, too, one of the two essential qualities is above another in importance. Generally speaking, the eating quality is the most important. Without eating quality it would be little object to have a keeping quality. The higher, too, the eating quality, the more quickly butter is likely to go into consumption, and the less necessity for long-keeping. Once again, a high eating quality can be secured only by a good make, which itself must answer not a little for keeping quality.

On the other hand, the flavor must sometimes be subordinated to the keeping quality, as in the case of butter to be shipped to markets so distant that keeping quality is imperative. Even where butter goes into quick consumption, it is often subject to exigencies which test its keeping quality, and this fact makes the latter quality again prominent.

A scale of points, therefore, ought at once to make two main divisions of the properties of butter, to afford also a means of judging in detail, and to allow some margin for adjusting the various properties in respect of the relative importance of the two main qualities under the special circumstances of the case.

The first scale of 100 points, given for a standard, in the foregoing, has some merit in these respects. The following will show the variations possible in that scale :—

SCALE.	FORM A.		FORM B.		FORM C.		FORM D.
Quality.	Eating	Keeping.	Eating	Keeping.	Eating	Keeping.	Eat'g & Keeping
Eating and Keeping......	20	20	25	15	15	25	40
Grain....................	5	5	7	8	8	7	10
Purity...................	5	5	7	8	8	7	10
Salting	5	5	7	8	8	7	10
Solidity.................	5	5	5	5	5	5	10
Packing	5	5	5	5	8	7	10
Color and Appearance....	10	..	10		10	..	10
	55	45	66	34	42	58	100

The above is more as suggestive than it is any claim to something established. Form D, fourth column, is the basis upon which variation may be made to suit the nature of the market.

It will be noticed that the giving of a place to the property of "purity" is apparently an innovation.

By purity here is intended freedom from what may properly be called foreign matter in butter—such as butter-milk, or caseine. Butter-milk, or even caseine, in excess in butter, is objectionable for a double reason. It is an adulteration, and it causes rancidity. Even water may be included in this point, if it be in excess, or if it be impure. Surely there is need enough to take into account this special property.

In order to judge of the purity of the butter, one must take into account the general appearance, along with a consideration of *process of manufacture employed.* If judges, or buyers, knew more of the circumstances attendant upon the manufacture of butter, they could generally estimate its value more justly than otherwise.

More attention given by persons interested to the *facts of manufacture*, including care and feed of animals, management of milk, manipulation of cream and butter, character of salt, water and tools employed, would help greatly towards the solution of the problem of improving the dairy industry.

Second. **Uniformity** is another important factor in the market. This quality is necessary:—

(*a*) **In the Package.** The practice common in small dairies of packing different churnings of butter in a single tub, throws upon the market a great deal of butter which shows several layers in a package, and all the layers more or less different in color, seasoning, etc. Even where the intrinsic value of the butter is not improved by the quality of uniformity, the value of the butter in the market, and sometimes the chance of a sale may depend upon such quality. The writer has in mind an instance where an excellent dairyman was unable to fill a small order, simply because one layer in a package had not a good color.

There are various ways of overcoming the objection of lack of uniformity. *First*, by having a large dairy, and packing a full tub at each churning. *Second*, by holding the butter in granular form until enough for a full package has been secured. *Third*, by such care in the process and packing that the butter will be as uniform as it is possible for different churnings to be. *Lastly*, by putting up *smaller packages*, as in pails, &c., for a near-by market.

(*b*) **Uniformity in the General Supply** of a dairy or a district is also important. One of the great advantages of the factory system is the fact that the general supply is very uniform. Having sampled a few tubs, the buyer safely makes a purchase of the whole. The sale is more easily made and better prices secured. Any satisfaction which the butter gives is helpful to the marketing of future lots. If the future lots possess the same quality of uniformity, the demand begins to assume an established character. Thus it is that in the marketable value of the butter product, uniformity becomes an important factor; the more this quality extends, or the more ground it covers the more advantages there is in it. It is an advantage for every dairyman not only to make uniform all the butter of a single season, but the same quality the next and subsequent seasons.

More than this, it is an advantage to every dairyman to have all the butter-makers of his district to make an article uniform in quality with his own, so that the whole butter of the district may be be worth being sought out, year by year, by rival purchasers, all eager to secure it.

Third. **Appearance.** Another factor in market quality of butter is appearance, both of the butter itself and of the package, or its covering and surroundings. The butter-eater enjoys eating butter only when he believes it to have been made by cleanly persons, in a cleanly way. Persons are met who never touch butter, because having in some way become disgusted with it at some past time. People will frequently judge by the appearance of the butter, the manner in which it is put up, whether or not it is clean and good. As it strikes the eye, so does the buyer judge the quality. Certainly intrinsic quality must support the appearance; but it is equally true that if appearance be against butter, however good its general quality otherwise, its market value will be depreciated.

Fourth. **Reputation** is another important factor in successful marketing. It seems strange that this matter of reputation is not accounted of more importance. The manufacturer in other lines is wiser in his generation than is the butter-maker. The piano manufacturer is careful to give his piano a name and to try to build up a reputation for himself. When he makes a poor article, he gives it the name of some other maker, real or fictitious, so as to lose nothing in putting something inferior on the market. As with the piano-maker, so with the cloth, leather, implement, and other manufacturer. If it be policy with the maker of goods that are necessaries and will be bought, to a large extent, even if of poor quality, how much more is it policy for the maker of butter which, being a mere luxury, will be bought, as butter, almost only in proportion as it is of first-rate quality.

A Bad Reputation is something to be avoided as one would avoid a stain that is hard to rub out. It is no easy task sometimes to establish a good reputation; but it is harder still to overcome the prejudice to one's interests created by a poor reputation. Mr. Mayer, at a Western Convention, in 1885, stated on the authority of an agent whom he sent to England, that some of the Canadian butter put along side of Danish butter, was the best of the two, and should have sold for more; but, owing to a deserved prejudice against Canadian butter, it sold for less. Upon every Canadian, then, who is interested in the success of the butter industry of the country, it is incumbent to do his part to wipe out a prejudice due to the past, it matters not whether he himself were in any degree to blame for the existence of such prejudice.

On the other hand, **A Good Reputation** has an absolute money value. It is said that when a valuation was made of Mr. Waring's OGDEN FARM, the GOOD-WILL alone was estimated at ten thousand dollars. Mr. Waring had been breeding Jersey cattle, and making gilt-edged butter, which sold at one dollar per pound. *Quality* was necessarily the basis of the high price; but once a reputation was established, the butter sold *upon its name.* Customers who bought the butter were confident that it would be good; and those who were buying live-stock trusted to get full value.

Mr. McPherson, known as the cheese-king of Eastern Ontario, has been a wonderfully successful man and has shown himself possessed of marked genius in the establishment of probably the largest dairy manufacturing business in the world, the character of which is unlike anything that preceded it. Mr. McPherson sold his cheese product at a good price, often in advance of the current price, and *by telegraph.* What alone enabled him to do this was a *reputation.*

Sustaining Reputation.—Having once secured a reputation, which can be done only by continued, persistent, intelligent effort, and honorable dealing, it should be guarded as the apple of the eye. To do this one must keep up to the standard always. If by some mischance there is defect in one's goods, send them off nameless, to stand on their own merits, and not on the merits of better goods that have preceded them. This is a policy that will pay. There is, too, a better motive: it is a course that is right, and one to follow which for the sake of right will give a man what money cannot give—self-respect.

Fifth. **Suiting the Market.** It is a cardinal principle in manufacturing that the liking of the buyer, or the demand, shall control the character of the make, or the supply. It is a principle that holds good in dairy manufacture to a larger extent than the practices of dairymen seem to appreciate. It is too common a practice of farmers to make such butter as a chance method happens to produce; with no thought whether it is the kind of butter which best suits the consumer who happens to get it, or whether it is suited better to some other market, or whether it is well suited to any market.

This is not the plan adopted by successful dairymen. The Danes always make an article suited to the requirements of the market in which they intend to sell. They make a butter whose chief quality is *long-keeping;* which is intended for shipment to warm countries. It is also packed in a special manner, suited to the requirements of the market. They make another butter that possesses less of the quality of long-keeping and has a more developed flavor; which is intended for and suited to the English market.

The French make two kinds of butter; salted and unsalted. American salted butter would not sell to the Parisians accustomed to unseasoned butter; and the French unsalted butter would not be appreciated by Americans accustomed to butter more or less seasoned with salt.

The success of Denmark and France in the butter markets of the world is due among other things to this cardinal principle. Want of success of some other countries is partly due to ignoring that principle. Its claims are imperative—every buyer will give preference to the thing that suits his judgment or fancy, with no thought of anything else, unless it be something that also concerns himself—price, and so forth.

There is one qualification of this principle, in its bearing upon dairy products. To a certain extent the appetite and liking is created by the character of the supply; in other words to a certain extent the taste of the consumer *may be educated,* or his preferences *modified.* The American does not like unsalted butter; but he can be led to buy butter that is light-seasoned, and when supplied with butter seasoned less than that to which he has been accustomed he will in time learn to like it and to give it the preference.

The lesson of all this is plain. Try to make a butter suited to the market intended; and if selling direct to consumers, cautiously educate them up to what is *better for themselves* and *more profitable to supply.*

The **Difference in Butters**, in a market sense, is first **in the Seasoning**. The only seasoning in butter is that of salt. There are three grades in salting:—

(*a*) **Unsalted Butter,** such as is consumed so extensively in Paris. The characteristic of this butter is a delicate flavor, which is not hidden by any seasoning. It is intended for a near-by market and early consumption, and it sells for a high price.

(*b*) The next butter is that **Medium Seasoned**. This is butter salted to the extent that *strong brine* would salt it, when in the *granular condition*. Butter, well-made and salted in this way, and not held over, but placed instead upon a fairly quick market, *ought* to be high enough seasoned, either for the English, American or Canadian palate. It would not please all consumers, but there will be a brisk enough demand for all the first-class butter of this kind that shall be supplied for some time, and a good supply of such butter would soon educate the taste of the consumer up to the point of preference therefor.

It is to be remembered that medium-seasoned, or in other words, brine-salted butter, should be preferably placed in a somewhat quick market. When made at its best, however, and kept under favorable conditions, it will stand keeping, if necessary.

(*c*) **High-Seasoned** butter is that which has been salted by the addition of dry salt to the strength of the brine salting; or it may be butter which has been altogether dry salted. Butter salted ¾ of an ounce to the pound and over, or 5 per cent. and upwards, may be said to be high-seasoned. Butter made in Canada and the United States in summer, and packed for winter use, or for export, is generally high seasoned. There are many consumers who, having been long accustomed to such butter, give it the preference even when it is freshly made. The too common habit of gathering butter into large lumps, and enclosing in it an excess of butter-milk and cheesy matter, has made such high seasoning somewhat necessary. By the adoption of the improved system, and the gradual education of the consumer, high seasoning may and should become a thing of the past!

The difference in butter, lies secondly, **In the Flavor**. The flavor of butter is something which is under the control of the butter-maker. It is possible to have a butter with a low flavor, or with a flavor that develops slowly, or one with a high flavor.

(*a*) **A Low Flavor**. There are two theories regarding the cause of development of flavor in butter. One regards this development as due to the *changes in the butter*, which are of the nature of decomposition; and the other regards it as due to *oxidation*, or to the influence of the air. The practical character of this MANUAL forbids giving more attention to *theory* than is necessary in order to arrive at a right *practice*. It is enough for the present for us to know that the practice is the same, whatever may be the right theory. We know that flavor in butter has to be developed, that development *requires time*, that development is very rapid in milk and comparatively slow in butter, that *exposure to the air* is of advantage for milk and not so for butter, and that development may be *hastened or retarded*. We know, too, that while development of flavor is under partial control, it cannot be wholly arrested; it will go on constantly.

Having in mind these facts, we may find a simple **Rule** that will guide us. *Furnish a butter which will have a flavor developed at the probable time of consumption to suit the taste of the consumer.* Butter not intended for immediate consumption must have a *low flavor*, and one that will *develop slowly*. Such a butter will have a long-keeping quality, and will better satisfy the taste that is dependent upon a distant market for its supplies. The mild flavor of such butter will be much preferred to the over-developed, strong flavor, and, perhaps, rancid taste of a higher-flavored, shorter-lived butter.

(*b*) **A High Flavor**. The butter whose flavor develops slowly, would be comparatively tasteless to the consumer of butter in butter-producing countries where supplies are constant, and where consumption follows production more closely than it does in some foreign markets. The eating of such butter has educated the taste for it, and, there being less need for keeping quality, such quality is sacrificed to a more quickly developed flavor.

How to Control Flavor. The Danish practice affords perhaps the best illustration of the means of controlling development of flavor. Cream is churned immediately after it is separated from milk that has been kept at so low a temperature, and set so short a time, that both milk and cream are still sweet. The result is a butter less in quantity but of extremely delicate flavor, and of good keeping and shipping quality, and made for that branch of export trade which demands it and will pay for it.

Where the Danes want a butter that will possess a high flavor when it is fresh, or one that will suit either the home or the English market, the cream is allowed to stand 24 hours and to become *slightly sour*. Thus it is that the development of flavor is controlled by *controlling the changes in the milk and cream before churning*. This is because of the fact that the development or change is very rapid in the milk or cream, and comparatively slow in the butter; the rapidity of change in both cases being affected by the care of the milk, and the method of manufacturing the butter.

There are other ways which will suggest themselves to the butter-maker, in which the wants of the market may be suited, to the advantage of all.

Sixth. **Quantity of Product.** Here we have another important factor in marketing; and the more distant the market the more important this factor becomes. Other things being equal, the larger the quantity produced the better the chance of selling easily and well. One of the principal advantages over private dairies of the factory system is due to this factor. The larger the quantity, the lighter the cost of handling, and the better the chance of sale. When the immediate local demand for butter is insufficient to absorb one's whole production, leaving a surplus for which a more distant market is required, it becomes an object to the dairyman to increase the quantity available for such distant market.

It is an advantage, then, to have whole districts given up to certain lines of dairy production; whether by the adoption of co-operative or factory system, or by the farmers of the district making somewhat of a specialty of a particular line of production. Under certain circumstances, then, the dairyman may welcome and encourage neighbours to follow him in his special line of production. This advantage holds good especially in the production of staple goods, for a more or less distant market, where the demand is large enough to more than cover the whole production of one's district or locality.

There are, however, circumstances under which it will be wiser for the dairyman to follow an opposite course. There are times when there is an over-production, and when prices are unprofitably low. Under such circumstances, the intelligent dairyman will, sometimes, find it to his interest to launch out into some line of production in which his neighbors are not generally engaged. Probably there has never lacked some opportunity to do this. The opportunity always exists, and it is only required that the dairyman have discernment and judgment to see and embrace it. For instance, there has not often been a full supply of fresh-made butter in winter. An increased supply would serve only to create a stronger demand, even at high prices. For a few farmers to engage in winter dairying is to relieve the summer market, to increase the aggregate consumption, and to stiffen prices.

Connection Between Consumer and Producer. There is nothing in marketing butter of more importance than keeping up such connection. If all the butter were equally good, this would be of little or no importance; but where quality is everything, as it is in butter, and when there is so wide a difference in quality as there is to be found in butter, the connection is of first importance. The consumer, or the buyer who supplies him, should know and be able to find the maker of the butter. Otherwise, the maker of the best quality obtains the average reputation, which is lower than he deserves; while the maker of a poor article profits in that the average reputation is higher than he deserves. If the proportion of bad butter to good butter be large, the injustice is still greater. One good tub of butter in ten will not raise the general reputation in any appreciable degree, to bring any measure of justice to the maker of that one good tub. When the disparity is in so large proportion even the maker of the poor butter does not seem to profit by his neighbour's loss.

The only remedy for this is to have the connection maintained between maker and buyer, or consumer. When the consumer buys butter that he does not like he will be careful to buy no more. But when the consumer finds upon his table a choice article he will be likely to rest satisfied only when he has gone to the source of it and secured a continued supply. This will really benefit all parties concerned. It is annoying to the consumer to go to his grocer for "More butter like the last," and be given another and inferior quality. To give him the best, and as much of it as he likes, is to make him a better satisfied customer and a larger customer. The maker of good butter will get more nearly what his butter is worth, and profit by and enjoy a well-earned reputation. The maker of poor butter will get at least his due; and the poor satisfaction that he will find in a slim reputation; and slimmer profits will, perhaps, induce him to adopt the best remedy—better methods and an improvement in quality.

Sell direct to consumers, if near by; otherwise sell only to a responsible and reliable firm, and upon condition that the butter shall go into the market not lumped in with a lot of inferior stuff, but with a chance to stand upon its merits. Let it not be sold as a job lot, but to fill an order that may be repeated, supplying to-day a market that may to-morrow have a further supply of just as good as what preceded it. Let the butter-maker ask his agent, the butter-dealer, to stand responsible for the quality of the shipment, the maker engaging upon his part to stand by the dealer.

In order to keep up such connection, the butter-maker should put his **Brand** upon all his goods in such a manner that the buyer can trace back to the maker when wanting further supplies.

It will always be an advantage for makers of good butter to adopt a pleasing name for their dairy; and in addition, perhaps, a particular style of package; or, in putting up butter in table shapes, to adopt a particular shape, or some emblem for the prints. In time one will have a **Trade-Mark** which will have a value in itself. As one increases his reputation, his brand, or trade-mark, will become of greater value.

When there is risk of the trade-mark being imitated, or, to use plainer language, being stolen, one may secure his property by **Registration**, in the way provided by Government, and involving very slight expense.

Where a whole district is engaged in supplying the same market, and the quality of the whole make is good, there would be an advantage in combining to make choice of a brand that would distinguish from all other butter the butter supplied in that district.

To lead up to this point, a few of the best butter-makers might unite, and take in others, as fast as these others would improve their methods and the quality of their make.

This is a sort of coöperative work that would be especially advantageous where other coöperative systems, such as creameries, factories, etc., have not yet been established.

To carry out the idea still further, a **National Brand** might be adopted, and all butter to be exported be inspected and graded. This would be a double protection. First, it would protect national interests. It sometimes happens that unscrupulous traders in neighboring countries palm off inferior goods under the name of the neighbor. It is done sometimes to get rid of poor stock without injury to home reputation; and sometimes to get the advantage of a foreign reputation. A national brand would avoid this risk, and would doubtless be of positive benefit in other ways.

Secondly, it would be a justice due to the makers of first-class butter, who suffer from the general bad reputation of the country, for they would not so suffer if butter were graded and the best brands were kept separate, in a way to establish a reputation at least for the best brands.

Eighth. **Holding Butter.** There are more than the **Seven Reasons** which follow why butter should be sold as soon as made.

1. Because dairy goods are at *their best* when *first made*. The exception to this statement is a very light one; it is where butter is made with unripened cream. Of the ordinary butter of the country it may be said that instead of improving, it deteriorates by being kept. The very choicest samples of butter have the largest proportion of the soft fats which are more easily digested, and possess the finest flavor, and are the shortest-lived. The hard butters have an excess of the hard fat, called stearine, which depreciates the quality.

2. Because the sale of dairy goods as fast as made, will *increase consumption*, the *reputation of the makers*, and the *prices*.

3. Because holding dairy goods turns the trade into *other channels*, and gives the whole advantage to the competitor, who places his goods on the market as fast as they are made.

4. Because it is *the practice of the most successful dairymen* everywhere to place their goods at once on the market.

In the Boston and other large American markets it is stated that most of the high-priced produce is sold within a week of its manufacture. The French send their butter to the English market within a week, the Germans within ten days, and the Danes within two weeks after it is made,

5. Because, butter-makers who *export* butter are, at the best, at a *disadvantage with competitors* who are *nearer* the market; and the practice of delaying shipment simply increases that disadvantage.

6. Because whatever is *gained by rise in price* is *lost in some other way*. When there is a rise in price it is confined generally to the freshest and finest parcels, and does not often benefit the stale lots. If one does gain in some special instance, it is likely that such gain is more than offset by the loss upon other occasions.

7. The holding of butter by makers helps to make the *butter trade speculative*, by introducing the factor of uncertainty as to the extent of supply.

The policy of quick disposal of butter is one not alone for the maker but for the dealer. The speculative tendency, wherever it exists, is hurtful to the general interests, and the butter-maker should condemn it by his own example, and by any influence he can bring to bear upon the dealer.

Make a butter that will keep, for there may be a lull in the demand, and butter be not salable; but when the market has fairly opened, do not hold for a rise. The non-speculative policy is the wisest policy for the producer, especially, of dairy goods.

Ninth. **The Trade Problem.** Perhaps no one thing has stood more in the way of improving the butter product of Canada than the system of buying carried on by local traders.

The first evil is the fact that everything was bought that was offered—good or bad—and the same price was paid everybody, without regard to quality. The effect was to discourage a disposition on the part of many makers to improve their make.

The next evil was the lumping together of all sorts, without regard to color, salting, or other quality, leaving it standing, perhaps, in a cellar or room filled with strong flavors from tobacco to coal oil, and then shipping it badly packed to sicken the market and eat one's own profits.

This state of things has been mending and will mend still further. Thanks to the better understanding of the dairy question than heretofore existed, it is now less difficult for the store-keeper to discriminate in buying butter; and he may pay according to quality.

It is now no difficult task for the store-keeper to improve his system of packing. On receipt of butter he may have it put into a cool cellar by itself, and well covered with saturated brine. Every day or two he may take a little pains in classifying the different lots, having special regard to bringing like colors together, where the parcels assimilate fully in other respects.

He may now, by the use of a *butter-worker*, re-work this butter, color it, if need be, and then pack it properly and ship it for immediate sale, to be *sold on its merits*, as store-packed butter.

The changes taking place in dairy practice are leading to a correction of this old and objectionable system of store trading in butter. The establishment of creameries, the increase in the size of dairies, the specializing of the industry of butter manufacture,—all are doing good work. Enterprising traders have it in their power to improve materially the state of things, and circumstances are now very favorable to any effort they may make either in establishing creameries, or in educating their customers to a better practice.

Tenth. **A Trade System** is another very important factor in marketing. In the improvement of the dairy industry in Denmark much credit is given, and justly, to the improved method of manufacture; but too little account is made of the fact that the trade system also has been improved.

Indeed, such improvement is coincident with success in dairying everywhere. Says Mr. Long: "The French farmers owe much of their extended trade to the system of middlemen. These persons visit the market and purchase the best samples of butter, which are made up in single lumps, the whole making of the week." In Denmark the large packing-houses and shippers make the very most of the situation, in some cases even to an oversight of the manufacture.

The lack of a system in the trade in England is referred to by Mr. Long as follows: "Even if the production of butter were at once doubled, we fear that imports would receive but a very slight check, owing to the *entire absence of any system* of bringing British butter into the (British) market! Until we have a system under which dealers are enabled to purchase farm butter *en gros* and place it in our chief markets, British producers of the best article will not obtain ready sale at remunerative prices."

Such a statement as the above would hardly be credible coming from a lesser authority; but the experience of many a butter-maker will enable him to see how possible it is to make a good article and be paid no better than a neighbor who makes a poor article; and all due to the lack of a trade system.

It is in the power of every progressive dairyman to help to supply this lack, where it exists, by making a good article and seeking a market which appreciates quality. Every butter-buyer will find it to his interest to move forward in this line. The impressive statement by Mr. Long, above quoted, will help to justify the importance attached in this MANUAL to the trade branch of dairy practice.

Eleventh. **Low Prices** are something to which every dairyman has a legitimate aversion. While low prices are not to be welcomed, they may be regarded as not wholly evil. The cheapening of such luxuries as dairy products can tend only to increased consumption.

It is in place here to caution the dairyman against changing his line of manufacture by reason of low prices. There is a temptation among producers to change from one branch of production to another, because the prices of one's own line are low. For instance, when cheese sells high, and butter low, there is an inclination to change from butter to cheese. It is not wise to do this, for the chances are that in the following season the conditions will be reversed. It is wiser to follow pretty evenly the tenor of one's way. To change often is to follow in the track of the advantage, and always be just behind; to remain in one's place is to get the full benefit of the reaction which is almost sure to follow.

When low prices are due to an over-production, however, it may be well to look about for some other line of production that has not been taken up, and so relieve one's self and the general producer.

Twelfth. **Storage.** Butter cannot be handled in any considerable quantities without suitable arrangements for storage. A cellar with a brick or stone wall, with a cement floor, will be an excellent place to store butter. The tubs should stand at least a foot higher than the floor. The place should be well aired, neither too dry nor too wet, and, of course, scrupulously clean, and free from odors. A box of lime should be kept on the floor to absorb the damp air, and the lime should be renewed from time to time.

In storing butter, see that the butter is in the right condition when first laid in, and examine it from time to time. Any faulty brine should be turned off and good brine substituted. One should have on hand, for use when wanted, a good *brine-holder*, containing a supply of brine, preferably made from *boiled water*, in which there may be a light proportion of saltpetre and sugar.

Thirteenth. **The Home Market.** Too often the home market is neglected. There is a field in home supply that would be profitable working for thousands of dairymen. The home market is a quick market; in supplying it one may get nearer to the consumer, be less dependent upon middlemen, suffer less from imperfections of one's neighbors, and so get fairer remuneration for one's labor. A foreign market is to be desired; but not at the expense of a home market. Every butter-maker who can cultivate profitably a near-by demand will be wise to do so.

Fourteenth. **Export Market.** The first market in the world is that of Great Britain. All dairying countries are striving for a foothold in that market. Continental countries have an advantage over Canada or the United States, because of nearness. They have an advantage, too, in some cases, because of having already a foothold in certain lines of supply. America has an advantage in her cheap lands, and in the greater aptitude of the people in devising new methods or making quick advance. This latter advantage has told well in the production and shipment of cheese; it has done nothing to its credit in the production of butter.

There is a profitable market in tropical climates that has been monopolized by Europeans. Though not a very extensive market as yet, it is doubtless capable of considerable development and opens a fine field for enterprise. This market is supplied with butter put up in sealed tin packages.

Fifteenth. What to do with **Strong-Scented Butter.** Unfortunately, there is sometimes in the market, butter which it were better to work over than to sell as it is. To improve such butter: Add to a pail of *cold* water about half a pound salt, and two ounces each of saltpetre and sugar. Slice butter in this water, to stand therein some hours. Pour off, and add *fresh* water, stirring the butter well about. Having removed the strong taste of the butter, and freshened it, press and salt it, using salt, saltpetre and sugar, in above proportions. Assort and add coloring when necessary.

THE DAIRY. The use of improved creaming methods has somewhat modified the need for a dairy; but in the sense that a dairy is a place set apart for dairy work, there is still need for such a thing. This place may be a house specially built, or a corner in a house used for other purposes, or even a house-cellar; but whatever it is, certain conditions should be met.

First. The dairy should have an **Exclusive Character.** Dairy Products are very aristocratic; they are so easily contaminated, by association with their more common neighbors that the only way they can preserve their luxurious quality is to be kept apart, when in court dress, from every-day association with their more plebian neighbors. So it is that they do not find a congenial home in every ordinary vegetable cellar, cook-room, pantry, &c. So it is that they seem better to preserve their high caste and fine quality only in a home by themselves, if not out of sight, at least out of smell of less delicate individualities. Yes, it is the birth-right of Mother Milk to have a home of her own for self and family.

Second. **Place Adapted.** In humble circumstances, the dairy family can put up with very modest apartments. They have been known to grow and flourish in an underground home, and come out with a color and freshness, and an odor, that vied with the out-door children of nature's own sunshine. That underground home was the **House Cellar**!

But there are cellars, and cellars. The meaning of cellar is a room in the ground under a house; the variety covers a range all the way from a hole to a cave, from a room to a cell. Except at their best, the ordinary house-cellar is a poor shift for *convenience* or *purpose.*

Think of them—with their stumble down, twist-about, dingey-dark stairways, whose sole merit, at a first sight is to prepare one for worse to come,—a poor virtue, and one which the possessor sometimes forfeits by leading one straightway to something even worse than it had prepared one for!

Convenience! Such stairways might do for a garret-room, to be entered only when one has been inspired to put some useless thing out of sight—never with the hope of finding anything; but what is to be thought of them for an every-day, every-hour journey for dear over-worked, over-worried life-mate, with her handfuls and pailfuls, of slipping kinds and slopping sorts!

One of the best kept cellars the writer has seen—a purely dairy cellar—had steep, dark steps, and a *trap-door!* Yet the dairy woman was one of the favored among women, for her husband was a kind man, who took pleasure in the comfort of his wife; and the man was one of the fortunate among men, for he had a cheerful help-meet whose excellent housekeeping talents were capped by a fine skill in butter-making. The larger, or vegetable cellar, though it was used less frequently than the dairy cellar, in summer at least, was provided with an easy door entrance. Neither man nor wife seemed to realize the inconvenience to which an ugly trap door subjected them.

The writer has seen one cellar stairway that seemed all that could be desired. It was wide, and straight, with low steps. It had a roomy landing at the top, and free foot-room at the bottom, within the easy door which opened to it from the upper rooms. The steps were just high enough and broad enough to make it like climbing a gentle slope to go up them. They were not adapted for office stairs for hurried men and leaping office boys; but they *were* in place in a cellar, and a valued treasure for quiet, tired mother, and well suited to even the light-stepping girls.

To provide a proper stairway for the house cellar would be an easy charity, or love, to hide a good many masculine sins; and full availment of the opportunity would make a pretty general tearing down and building up throughout the land. Shame men! Let the rainy or idle days for some time to come, witness not a little amateur architectural employment among the men, the good wives being chief advisers. The front door? Oh! yes, come to think, it does need a little fixing up. But let it wait; a well wife, and a *fitness of things inside,* will do not a little to make up for some roughness in outside appearance.

A great convenience to a house-cellar would be an *outside entrance.* Carrying milk to and from the cellar through the kitchen is a useless labor and annoyance that may be avoided with little cost.

Space will not allow full treatment of all the inconveniences associated with the typical cellar. How about the *purpose* the cellar is intended to serve?

Cellars should be cool. Well, are they not cool? On a summer day when we are sweltering under a hot sun, or sweating in close upper rooms, the very thought of a cool, damp cellar gives one a slight crawl of a chill that is quite pleasant. We enjoy the thought even more than the reality; for many a precious home-body, heated and flushed from the fire of a kitchen, must needs stay so long in the cellar, standing on its cold damp floor, that she finds a reality of chill that means a "death-a-cold!"

How long will it be till some change come over the character of the cellars under the dwellings—the places for storing meats, vegetables, fruits, oil, milk, butter, traps; growing bacteria, manufacturing typhoids, domiciling rats;—a sort of underground magazine constantly menacing that blessed Christian institution which is right overhead—the dearest spot on earth to you and me—Home!

The exclamation points that force themselves to appear in a treatment of this subject are so many as to offend against refined literary taste; but the offence is not to be compared to the offence against our intelligence and humanity that lurks in the average cellar!

The questions of Sanitation and Profitable Dairying is perhaps nowhere more intimately associated than in this cellar question. This is so true that the writer needs to make no excuse for presenting two striking pictures that were drawn from real life, by Prof. R. C. Kedzie. Reader look on these two pictures; first on the one and then on the other:—

A BRIGHT PICTURE.—"Two brothers in Vermont, of strong and vigorous stock, and giving equal promise of a long and active life, married wives corresponding in promise of future activity. They had both chosen the healthiest of all callings—farming. One of the brothers built his house in an open and sunny spot where the soil and subsoil were dry; shade trees and embowering plants had a hard time of it, but the cellar was dry enough for a powder magazine. The house in all its parts was free from every trace of dampness and mold; there was a crisp and elastic feel in the air of the dwelling; the farmer and all his family had that vigorous elasticity that reminds one of the spring and strength of steel; health and sprightly vigor were the rule and sickness the rare exception. The farmer and his wife, though past three-score, have yet the look and vigor of middle life."

A DARK PICTURE.—"The other brother built his house in a beautiful shady nook where the trees seemed to stretch their protecting arms in benediction over the modest home. Springs fed by the neighboring hills burst forth near his house, and others by his barns; his yard was always green even in dryest time, for the life-blood of the hills seemed to burst out all about him in springs and tiny rivulets. But the ground was always wet, the cellar never dry, the walls of the room often had a clammy feel, the clothes mildewed in the closets, and the bread molded in the pantry. For a time their vigor enabled them to bear up against these depressing influences; children were born of apparent vigor and promise, but these, one by one, sank into the arms of the dreamless twin-brother of sleep under the touch of diphtheria, croup and pneumonia; and the mother went into a decline and died of consumption before her fiftieth birthday, and the father, tortured and crippled by rheumatism, childless and solitary in that beautiful home which elicits the praises of every passer-by, waits and hopes for the dawning of that day which shall give him back wife and children, an unbroken family and an eternal home."

"Ik Marvel" was in search of a farm. He found one, the appearance of which "forbade any doubt of its positive attractions. There was wood in abundance, dotted here and there with a profuse and careless luxuriance; there were rounded banks of hills, and meadows through which an ample stream came flowing with a queenly sweep, and with a sheen that caught every noon-tide, and repeated it in a glorious blazon of gold. It skirted the hills, it skirted the wood, and came with a gushing fulness upon the very margin of the quiet little houseyard that compassed the dwelling. And from the door, underneath cherry trees, one could catch glimpses of the great stretch of the Hudson, into which the brook passed."

But "Marvel" learned that *fever and ague* had driven the previous occupant from the beautiful but *over-shaded*, *over-watered* homestead, close to whose dainty lawn the brook surged along, brimful and deep; and the place took on a new aspect:

"Its cool shade seemed the murky parent of miasma; the wind sighed through the trees with a sickly sound, and the brook, that gave out a little while before a roistering cheerfulness in its dash, now surged along with only a quick succession of sullen plashes."

The writer has in mind a beautiful, dreamy, old homestead, that nestles quietly at the foot of a hill, under the shade of a fine maple grove; but the delicious coolness of shade is oftentimes the cold chill of dampness—fever lurks about, and mold is always near. A new house and a new cellar are needed, either for health or butter-making; and it were better to break the mournful romance of old associations, and to build out from under the grove and from under the hill, to get the longer smile of cheery sunshine, and the heartier kiss of breezy air.

Doubtless a house-cellar is not absolutely and unredeemably bad. There certainly is so much of possible economy and convenience in it that it will be a long day before it will go. The writer has spoken in somewhat harsh terms of the cellar, not to urge that it be abandoned, but rather to suggest that it be improved. One does not need to wait till building a new house before he may possess a cellar of some value. It is better to do at once what is possible to correct defects in the old cellar.

First. See that there is **Drainage**. Provide a tile or gutter that will carry off the water and keep the cellar dry. The cellar, being low, will often drain the surrounding soil, unless itself be provided with drainage. The better drainage, from a sanitary point of view, would be that ensured by laying drain tiles all around the cellar and running into a tile drain which will conduct the water to some point at a distance. Mr. Waring recommends laying the tiles one foot deep and one foot inside the walls of the cellar.

Second. Make a good **Floor**. The natural earthen floor in a cellar has sometimes much to recommend it. A well-drained, dry, hard, but porous floor, under favorable conditions is a good floor; for fresh earth is a good absorbent and disinfectant. The difficulty is that after a time the disinfecting power of the soil is partially, or wholly lost; and itself becomes a source of deleterious gases. Such will be the result in time under *ordinary circumstances*, or where decaying vegetable matter is stored in the cellar, and liquid runs down, or is spilled upon the floor, or where the surrounding earth-wall of the cellar becomes saturated with the drainage of house-slops, and with other impurities. An earthen cellar-floor that is a disinfectant when new, too often becomes a foul reservoir of impurity when old. On the whole, the best cellar-floor is one of cement concrete.

A good cellar-floor may be made in the following manner: mix well, in a shallow box, four parts coarse gravel (or broken stone and sand) with one part cement. Slack one part lime and add to the above mixture. Shovel the whole from end to end of box till the whole is thoroughly mixed, adding enough water to cause the whole to cement together when laid. Lay about six inches of this cement on the bottom of the cellar; and when it has well set, make it smooth and even, with a thinner coating of one part cement and two parts sand.

Other suggestions for a cellar floor will be found in the descriptions of dairies, to follow.

Third. The **Walls and Ceiling** should be *finished;* just as any other room above is finished. Cement the walls; lath and plaster the ceiling. Give a hard, smooth finish; and then whitewash all every spring and fall. Is the cellar dark so that holes in the wall, and the dirt, are not seen? All the more need of correcting these defects that would otherwise elude one's search. The cement wall will also keep out the gases from the soil; sometimes the percolations through the soil, of kitchen-slops (for carrying away which there is too often insufficient provision) will find an entrance in the form of gases, to the cellar, through the defective walls.

To finish the walls, first fill up the large holes with coarse mortar. If this does not make the walls smooth, a coat of cement-plaster would be desirable. As a last finish, the following would serve: In a small basin, mix cement and water to about the consistency of cream. Apply with a large paint brush, or a small-sized whitewash brush; constantly stirring the mixture to prevent the cement from settling to bottom. Mix only in small quantities, say half a gallon at a time. Though the above may be easily brushed off when first put on, it will harden in 24 hours.

Fourth: Cellars should be **Ventilated**. The ordinary cellar is a possible reservoir for holding carbonic acid gas from the rooms above. The vegetable and other organic matter stored in cellars, undergoing constant decomposition, evolves gases which, in turn, find their way to the rooms above. Thus each is an evil to the other. Even from the ground, especially in old cellars, there may be escaping gases which find their way to the rooms above.

The only way to avoid the evil is to give the cellar ventilation, and by other means than by a chance escape through the cellar-door opening into the rooms overhead. This may be accomplished, in summer, by suitably constructed windows; but not so in winter.

The least that can be done, and the first that should be done, is to provide for the exit of the air of the cellar. This may be accomplished by a flue, leading from some point near the ceiling of the cellar, into the chimney; or if that be not feasible, it should lead up through the house and out near the roof. Fresh air may be admitted, from the rooms above, through a ventilator near the cellar door. A better plan would be to provide an entrance through a window or the wall of the cellar. Construct a box flue that will bring in the fresh air and carry it down to a point near the cellar floor. A still better plan for providing fresh air would be by means of an underground pipe, as described farther on under the head of general ventilation.

Such ventilation as just suggested may be brought under control by means of simple slides for opening and closing the flues, partially or wholly, at will.

A cellar should not be aired in the warmest part of the day. In the cool of evening, open the windows freely; the cool air will ventilate the cellar and the cellar will be cool, but not damp. Early in the morning let the openings be closed.

Fifth. A dairy cellar should be **Separate**, or by itself. If one cannot have a wholly distinct cellar devoted to the dairy, it is at least easy to have an end, or corner, of cellar partitioned from the rest of the cellar, and a tight door. This will do very well if the bulk of farm produce is not kept in the outer cellar, where it certainly should not be kept.

The time will come when cellars under the living rooms of houses will be less common. At least their present use for storing everything and so much of everything will be restricted; and the cellar will be constructed and occupied in a manner that will make it possible to subject it, like the upper rooms, semi-annually, or oftener, to the ordinary rules of sanitation and hygiene. Properly built, reasonably filled and frequently renovated, the cellar yet may become as excellent as it is now intolerable.

A **Pantry Dairy**, or a dairy off the house rooms is not the best, yet it is sometimes the lot of our aristocratic milk family to abide therein. It sometimes happens that farmers with small dairies do not feel that they can afford the expense of a separate dairy. When it is necessary, then, to make butter under the inconvenience of a pantry dairy, let that dairy be made as suitable as possible, and everything not of kin with milk so far as possible be excluded.

It is under such circumstances that the deep-setting system of creaming will be especially an advantage. Given cold water and good creamers, it is certain that the milk may be set to throw up more and better cream than can be obtained from milk set in shallow pans, on pantry shelves, surrounded by all sorts of products that are well enough by themselves, but of too base a sort to associate with our more delicate milk family.

AN Out-Door Dairy, or a dairy proper. The sister-products—butter and cheese—seem to take on a more healthy bloom when their dairy-home has been made expressly to suit the nice tastes of this somewhat particular family. More than that, such a dairy will give the dairymaid the heart to sing the poetry that certainly is and ought to be in the dairy. She could sing of a dairy proper, but not of a cellar. Listen to the song of the dairymaid, as sung in the *Michigan Farmer*:—

"About five o'clock in the morning I go into the milk-room to attend to skimming and straining the milk. I get the fresh air, and drink in all the beauties of a morning in the country; the sun is fast peeping up in the east, almost hid by a clump of trees; the dew is sparkling on every blade of grass and leaf; the birds are reveling in a perfect flood of melody; the cattle are lowing, lambs are bleating, chanticleer is telling shrilly that morning has come; the little chickens and turkeys are peeping for their breakfast; and as I feel the blood coursing through my veins with quickening pulsations, sending a glow to my cheek and adding strength and health, I know it is better than if I had slept the morning away, or stood in a damp cellar skimming milk."

Aye, both the pleasure and profit will be enhanced by the possession of well-located, well-built, well-lighted, well-fitted, out-door milk-house.

The dairywoman who thus cheerily sings at her work, gives further reason for her liking. She had proven by actual experience that a cellar was not a good place for milk; for by using an out-door milk-room, she had been enabled to dispense with all "running up and down stairs with milk, and carrying pans." She found, by being careful about spilling milk, that once a week was often enough to wash the shelves , and, better still, it became convenient for the men to handle the milk, to and from the dairy.

An out-door dairy need not necessarily be very expensive. Like in anything else, there is quite a range in possible cost. In the old world there is an expenditure of capital on dairy and other buildings that wisely would not be thought of on this side the water. Large stone buildings, of elaborate finish and an inside equipment to correspond, are not rare in some countries.

Here we read of a long-ago "moss-covered spring-house" of the Western States, described by Edward Egglestone in his "Circuit Rider," where Patty's lover came to her, on one momentous morning of her life, just after she had filled the second "crock" with milk, adjusted it to its place in the cold current, and neatly covered it with a clean block. This was doubtless a very primitive structure, but there are thousands of dairies not advanced beyond that pioneer state of things.

The next stage of advance from the spring-house, for milk-setting, is the more or less common frame, or stone, building of more elaborate structure. One form of this dairy is a building located partially under ground, with the floor from four to six feet below the surface, and entered by an out-door stairway. It is usually built of stone, and cemented, and sometimes a stream of water is led into and through it.

There are districts in which this sort of dairy has become somewhat common, to the marked improvement of the local reputation of butter. These dairies are a cheaper form of the larger and more expensive stone dairy-houses, so much more common in the old world.

Almost the whole building may be made of stone, or concrete. Wood may be used only for windows, roof and ceiling. The ceiling may be of matched lumber and shellacked ; or, if preferred, it may be lathed and plastered. There will be no object in making any use of the garret, in a cheap dairy-house of this kind.

The writer strongly recommends a milk-house of this character to the farmer who, having a small herd, requires a separate dairy, but wishes the best that can be constructed at a low cost.

A gravel-house would be well-suited for a dairy, and may be put up cheaply. It is built of gravel, sand and lime. The relative proportion of gravel and sand depends upon the fineness of the gravel : the finer the gravel the less sand, the coarser the gravel the more sand. Where the grains of the gravel are from the size of peas up to hens' eggs, the proportion may be as follows : Clean gravel, 15 bushels ; clean, sharp sand, 3 bushels ; and lime, 1 bushel. For coarser gravel, increase the proportion of the sand considerably, and of the lime slightly.

In other words : One bushel of lime to 15 bushels of gravel, with sand enough to fill in the crevices.

To lay the walls : Make a temporary board frame to serve as a mould in which to cast the wall, to be removed when the wall has hardened. Build up the wall slowly, to allow it to harden and become firm.

A **Cheap Milk-House** may be built as follows : Size—inside, 10 × 12 feet ; outside, 12 × 14 ; one and one-half stories. A wall is built of brick, stone or concrete. Excavate the earth inside the wall to a required depth, say from two to four feet, or even deeper, if good drainage can be secured. For a floor, pack the earth solid; or, better, make a concrete floor. Build an outside wall of upright boards, closely battened. Build an inside wall *for the lower story*, of narrow, matched stuff, closely joined, and well nailed. The floor which separates the upper and lower stories also should be matched. This will leave between the two walls a twelve-inch air space—a dead-air space, as it were. The gables will be north and south, with a door in each, that both may be opened to allow circulation of air in the upper story for ventilation. On the north and south faces make openings, one at each corner—say, one foot wide and four feet high. Cover these openings with fine *wire gauze ;* and provide them with close-fitting sliding shutters, that may be opened and shut at will. At sun-down these shutters will be opened to allow the cold air all night to circulate freely in the air-spaces between the walls ; and in the morning they will be closed to exclude the warm air of the daytime from those spaces.

The building will be covered in by an ordinary roof.

A milk-house of the above description, put up in California, though only 18 inches below the surface of the ground, maintained an inside temperature sometimes nearly 30° lower than that outside ! It provided for the care in shallow pans of the milk of 40 cows !

Another Plan, and somewhat similar, was adopted by Mr. Mulock, a member of the Dominion Parliament. It was a one-story building, resting on a stone foundation, and entirely isolated from other buildings. The wall is ceiled between the studs, so as to form two chambers. The inner wall closed up to form a dead-air space for protection against heat and cold. This inner wall is lathed and plastered; except that part of the building devoted to keeping ice, which is ceiled with matched boarding. The outer wall is boarded with V-jointed stuff, and painted. This outer air-chamber is left open into the attic at the top. It is also provided with a ventilator, at the bottom—at the sill below, extending all around the building on the outside, and opened or closed by a hinged siding board. By opening this ventilator a column of air is made to pass up inside of the outer boarding, and out through ventilators in the roof, thereby preventing the sun's heat from affecting the inner parts of the walls.

The roof is hipped, each side thereof being relieved by a gable ventilator, and finished at the convergence of hips by an ornamental ventilator.

The inside is divided into eight compartments, viz., cream-room, churning and working-room, butter-room, wash-room, boiler-room, and three ice-rooms. All except the ice-rooms have the walls and ceilings finished with best cement, which is smooth and hard, will not absorb germs, and can be washed without injury. These five rooms, also, are furnished with a smooth, hard cement floor. The floor has a down grade, from every point to a basin in the floor, at one corner of the wash-room; so that water thrown on the floor for scrubbing and otherwise, will run to the basin and pass away through a four-inch trapped sewer pipe.

The top of ceiling joists over all the rooms (except ice-rooms) is floored with matched stuff, to keep out winter's frost.

Fresh air is brought into each room through a six-inch pipe, which runs down from the floor *seven feet under the ground*, for a distance of 100 feet, and then rises up four feet above the ground, where the air is pure. Each of the five rooms has a *valve ventilator* in the ceiling, which may be opened at will to carry off foul air, and admit fresh air through the underground pipe mentioned.

The foregoing was designed by a Toronto architect, and certainly presents points that are very valuable.

Third. **Well Located.** In selecting a location look to coolness, drainage, purity of atmosphere, and fresh water abundant and convenient. A northern exposure, and high ground will ensure coolness, dryness and air circulation.

There is no objection to having the dairy somewhat shaded, but close enough proximity of trees to ward off all sunshine is objectionable. Shade, while it means coolness, also means darkness, stagnation, dampness and mold. An open space, while it is sometimes warerm than desirable, is sunshine, air-circulation, dryness and healthfulness. Let the situation be open and airy; and be far removed from swamps, marshes, stagnant water, stables, pig-sties, cesspools, dung-heaps, or any other odorous or foul matter.

Both the dairy and water supply will generally be located conveniently near the dwelling-house. This makes it necessary to correct the defects of the home surroundings. The health of the home itself, as well as the need of the dairy demands that this be done.

It would be well to have all other outbuildings as far away as possible from both the dairy and the water supply. But if these immovables are already located too near, some provision should be made to lessen any evil of their nearness. Look first to the manure heaps, with their unwholesome gases escaping—itself a direct loss to the farmer. Economy and sanitation both demand action here. These heaps should not be allowed to remain near at hand so long that the odors therefrom will reach the dairy. Neither should they be on higher ground than the dairy itself, lest streams of manure-waste reach the dairy.

The water-closets are under the same law imperative. Not alone should they be removed as far as possible, but provision should be made to save all deposits for plant-food, and to prevent dangerous disease in the form of nauseous and deleterious odors stalking forth from them.

The frequent use of a few shovelfuls of *fresh earth* kept at hand in a box, with a plentiful supply stored near by for convenience, is the simple and inexpensive precaution that will accomplish wonders here. It will be well to use a small quantity of lime along with the earth.

A box say two feet wide and deep, and of convenient length, made strong, of plank, at a cost of a few cents, will be a simple means of receiving the deposits and for removing them from time to time. A strong iron staple, or link, into which a hauling hook may be attached, fastened in one end, will serve for drawing the box to a distance. Having two or more of these boxes constructed at one time, there will always be an empty one at hand ready to replace the one just removed. The unused empty boxes will be left at a distance in some corner of a field on the farm. A liberal use of any cheap and effective disinfectants, such as earth, lime, copperas, carbolic acid, &c., is recommended.

About the outbuildings, a great deal of unsightly rubbish is likely to accumulate. Let this be swept away and all the corners be opened to the disinfection of air and sunshine. Some of the buildings might well be whitewashed.

One great and common difficulty in the sanitation of dwelling houses, is that of getting rid of the kitchen or back-door slops; dish-water, mop-water and wash-water too often are thrown upon the ground, immediately at the door! It is impossible to secure freedom from miasm, if this practice be followed. The ground becomes saturated with organic matter, more than it can possibly disinfect, and the air becomes loaded with bacteria; all of which is unsanitary and *undairysome*.

Of all sources of disease—malaria, diptheria and typhoid, one of the most potent and least suspected is this slop-puddle, that cosmopolitan back-door feature of palace and hut. The saturated soil refuses to drink up this waste water so fast as it is thrown out, and in a little soil-basin which soon forms, the water stands until the air is filled with its exhalations. Draining, little by little, through the soil the poisonous gases evolved find exit in cellar, drinking wells, and air, till the whole district is "soddened with foulness."

The only remedy for this evil is to have *all waste water*, be it *pure or foul*, wholly removed from the immediate precincts of the dwelling-house, dairy and water-supply. It may be conveyed to the manure-heap; or to a distance, to be spread upon the garden, or other land that is *under tillage*. It may be conducted a short distance to a heap of ashes, coal, muck or soil; which heap may be occasionally drawn away for manure and replaced with a fresh heap.

If one has such a puddle at the back-door, and has not yet devised a plan to get rid of it, one thing, at least, may be done in an hour. With a wheel-barrow, or even an old pail, one may cover the puddle up deeply with ashes, coal, fresh earth, lime—any or all of these. After a few days, this may be wheeled off and spread upon the land for fertilizing purposes. This is a measure for temporary relief; but it should be followed up by some plan for a more permanent prevention of the evil.

This slop-waste is worth saving as a manure; but, rather than suffer from its influence, it would be better to adopt some plan that would carry it off altogether. A very simple, and apparently effective, plan of accomplishing this purpose has been brought to the notice of the writer. Piping is laid from the kitchen, or back-yard, to a point at a convenient distance from the house, into garden or field. Here a hole is dug deep enough for the purpose required, and as large as a barrel. A few stones are filled in the bottom, and a quantity of lime is thrown in. A barrel is then set in, *bottom upwards*, and the lower end of the piping referred to enters this barrel. This pipe carries the house-slops to a sufficient distance and depth to get rid of them. The space inside the barrel holds each emptying until it has had time to percolate into the ground. A *small* pipe, long enough to reach above the surface of the ground, is inserted in the head, or top, of the now inverted barrel, and the hole is filled up level with the ground. To prevent this pipe from being stopped up by some chance obstruction, the end is bent over slightly downwards. The use of this pipe is to carry off the gases which may form in the slop waste beneath. When it would be required to save the slops, say for garden irrigation, it would be necessary, of course, to carry them in the ordinary way, with pails. The advantages of this plan are not confined to farm houses; they are even more available in villages and small towns. Second-hand gas-pipe can be bought for this purpose very cheaply. Wooden pump-logs would do for it.

Fourth. **Well Ventilated.** Stagnant air, like stagnant water, must be guarded against. Purity of atmosphere, like pure water, where organic life exists, can be maintained only by changing the air freely. Ventilation may be accomplished through the windows; but as, for sake of temperature, there must not be too many windows, and what there are should be constructed to close tightly, it will be well to make special provision for more readily controlling ventilation. This may be accomplished by openings in the wall. Such openings may be from north to south; or even from east to west. They should be at both top and bottom—floor and ceiling. Provide them with a wire screen, and a shutter, both moveable—shutter outside, wire inside, both sliding.

Light and heat, the agencies of life, being more or less shut out from the dairy, make it all the more necessary to utilize the kindred agency—air. Wanted, fresh air, pure air, or air in abundance, air in circulation.

In ventilating a room the outside air should not be admitted when it is very much warmer than the air of the cellar. The moisture held in suspension in the warm air would condense in the colder air of the cellar, and be deposited on the floor and walls of the cellar. Where the ventilation is very perfect, and the circulation is free and continuous, the warmer air may be admitted with more freedom. Where the fresh air is brought a long distance underground, it may be admitted even when the outside temperature is high, for in its long underground passage it becomes cooled. Suggestions for ventilation made in other connection need not be repeated here.

Fifth. **Free from Dampness.** An atmosphere does not always need to be dry. Indeed, it should be somewhat moist. In warm weather moisture is a great help to coolness. But there is a difference between moisture and dampness. One may be for a moment, the other is more or less lasting. By placing a vessel of water on the stove we make the air less dry, or give it moisture; by saturating the floor and walls of a room, we make a place damp. A pure, moist, atmosphere, like light, promotes health of the higher orders of life; a muggy, damp locality, like shade, quickens the growth of fungi, bacteria, the germs of decay.

Dampness is avoided by a high location, good drainage, light, ventilation, &c.

The material of the building, and its construction, has much to do with immunity from the death-chill of dampness. A hard, smooth surface, impervious to water, may be washed and quickly dried. A porous material will absorb and retain the moisture. The floor and walls of a dairy should be hard and smooth, so as to be easily kept dry.

The floor, being a level, and being more frequently dampened, requires more than the walls to be water-tight. One of the best dairy floors is that made of cement. A stone floor is good. The interstices require to be filled with cement. The stone floor is more expensive, and if not well laid is not so even as cement. A good floor is made of cobble stones, gravel and cement; it is, perhaps, the best for its cost. Brick will do; but it is too porous. A board floor is not to be despised, when it is well made. The boards should be well-seasoned, smooth-planed and well-matched. A dairy floor should have a gentle slope to carry off the water.

For laying down stone flags, the following plan is given: Make a good bed of sand or dry earth, and pack it as hard as can be done with a rammer. Make the bed perfectly even, and pack again. Give it the slope required for the floor. Make a mortar with good cement, one part; and resin and sand, two parts. Mix with water till it becomes a pasty mortar. Make a good bed of mortar underneath and between each flag; as in ordinary stone-laying. Mix the mortar in small quantities, for it quickly dries and spoils.

To make such a floor water-proof: Soak it well with hot gas tar. Old pans filled with coals, and set upon the floor, when applying the hot tar, will heat the floor and make it soak up the tar more effectively. Such treatment will improve the floor by making it harder, more durable, and more easily kept sweet and clean.

To take precautions against dampness, is more necessary in a dairy than in ordinary rooms. This is because it is necessary to shut out, to some extent, light and heat, for purposes of keeping the temperature down.

A dairy, or factory floor, should be elevated enough from the ground to ensure a circulation of air beneath; unless it be, like a stone or cement floor, built directly on the ground. To help secure dryness, a dish of fresh lime in the dairy is invaluable. We are told that a peck of lime will absorb 7 lbs. water and seem like a dry powder. Lime, when it has been so used for a while should be replaced with fresh. It need not be wasted; it may be thrown into the manure heap.

Sixth. **Free from Mould.** Mould is due to dampness. One is sometimes bound to a cellar or other room where dampness cannot be wholly prevented. In such case an effort should be made to destroy the mould. The following easy plan has been adopted:—

Put some roll brimstone in a pan in the room, and set fire to it. Close the doors and windows tight, and leave for several hours. Repeat at intervals of two or three months.

Frequent disinfection of such a mouldy room should be made, say by means of a box of lime, or a vessel of dissolved copperas. Again, whitewashing walls is necessary. Before whitewashing mouldy walls, wash them in a solution of copperas.

Seventh. **Even Temperature.** The warm temperature that comes from the free admission of sunshine and air, is in itself a good thing; but it must needs be dispensed with sometimes for sake of coolness, in the house, and even more in the dairy. The whole process of butter-making is so much dependent upon temperature that it is necessary to get this element under control—even at a sacrifice of the other desirable agencies, light and heat.

The best average temperature for a dairy is 60°, or, it may be, lower. Such temperature can be secured by location, construction of building, etc. As to *location*, the building is given a northern exposure, and lighted mainly by windows at the north.

Air is a slow conductor of heat; therefore, to secure even temperature, the walls of a building may be built to contain one or more **Air-Spaces**, or spaces closed to prevent circulation of air. These are either closed to form dead-air spaces, or they may have valvular openings by which to control the air-currents.

The larger these spaces, and the more of them, the better the temperature is controlled.

In the description of different dairies given in this MANUAL, will be found suggestions of several methods of securing even temperature by air-spaces. In one method we have a single dead-air space between the walls, the air in which could be changed at will by ventilation. In another plan we have two air-spaces in the walls, and the ventilation is supplied only to the outer space. Still another plan is that of having three or more dead-air spaces, with no ventilation for either of them.

Even temperature is secured, also, by using for walls and covering of building, material that is a **Non-Conductor** of heat. There is nothing that equals *paper* for this purpose, taking into account its cheapness. *Wood* is good and cheap; so is *stone* and *concrete*.

Charcoal or *sawdust* are both good material for filling up spaces within or between the walls.

Color, too, has something to do with evenness of temperature. White is a non-conductor of heat, while black is heat-absorbent.

Everyone knows that **Water**, standing in vessels, or sprinkled upon the floor, will lower the temperature of a room, in warm weather.

There are many ways of using water for the desired purpose: a dairy may be built over a living spring, a running stream may be conducted through the dairy; or fresh, cold water may be brought into the dairy, by pipes or other convenient way, and there stored in vessels, or barrels, or a reservoir, for free use as required.

Wet blankets or cloths, hung up in a room, say upon a clothes-line, or hung near the open doors and windows, will have a wonderful effect in cooling a room for the time being, in summer. This plan might be availed of, especially when the temperature of the room for churning and working butter is higher than that of the water.

One way of securing even temperature is to build the **Ice-House** adjoining the dairy. This would be best secured by building the ice-house on the south side; but it would not be an economy of ice. It is better to build on north side, or west, or east. Openings, or ventilators, through the partition wall will let in the cold air from the ice-house, and the warm air will pass out through a ventilator.

A good system of keeping the air at an even temperature, and, at same time, providing good ventilation, would seem to be that of bringing in fresh air by means of an **Underground Duct**, made of some fairly good heat-conducting material. This channel should be several feet below the surface; it should run a distance of 100 feet or more, and rise three or four feet above the ground, at a point where the air is pure. Ventilators in the dairy rooms, at or near the ceiling, will carry out the impure air, which will be replaced by the fresh outside air, drawn in through the underground channel. The air may change quite fast enough, and yet pass through the duct slowly enough to warm it in winter and cool it in summer. This duct may be made of drain-tile pipes; or it may be an earth drain.

Eighth. **Water—Pure, Abundant, Convenient.** Water is an absolute essential, and upon its supply, abundant and convenient, depends the success of the dairy.

Water running through the dairy continuously is the best way of all. It keeps the atmosphere pure, the temperature even; it is available for milk-setting, and for cleansing purposes.

If other essentials can be reasonably secured, let even the water privilege determine the location; that is, if water cannot be brought to the dairy, let the dairy be taken to the water.

Ninth. **Drainage.** Thorough drainage is an absolute essential in a dairy. It should be secured partially by *location;* and then by means of good *drains.* As to location, both hygiene and dairy-work demand that the site be high and dry as possible. As to drains; make the construction of them a matter of extreme care. Let the drain have a good slope, and give it an even and smooth bottom; that it may be an unobstructed channel to carry off everything that can enter it.

Let the floor be water-tight, and slope from all sides to the drain. Let there be bars at the mouth, to prevent entrance to the drain of anything that might lodge therein. The mouth of the drain should be trapped, too, with a door, or valve, that may be opened or closed at will, partially or completely.

A drain should be flushed occasionally, with a stream of clean water.

Without great care be taken, the drain, instead of proving a prevention of harm, by carrying off waste water and dirt, may prove a source itself of noxious gases and disease.

Tenth. **Divided into Compartments.** A complete dairy building will necessarily consist of several rooms. The churning room and general work and wash room may be in one, and conveniently will be, doubtless, the largest room. The creaming room should be by itself. It will be an advantage to have a third room for storage—a butter cellar, as it were. This should be in the coolest part of the building and completely shut off from the other room, and may be a very small room. One may easily plan these rooms for himself, to suit his own special needs.

White-Wash Paint—Cheap and Good: Slake half a bushel of fresh lime with boiling water, keeping it covered during the process; strain through a fine seive, and add seven pounds of salt, previously well dissolved in warm water; have ready three pounds ground rice boiled to a thin paste, and stir in hot; also have ready half a pound of powdered Spanish whiting, and a pound of best clear glue, well dissolved in warm water;—mix these well together, adding hot water, if necessary, and leave the mixture standing for some days, well covered.

Glue should be dissolved by soaking in warm water, and be kept liquid, or soft, by hanging over a slow fire, in a small dish, immersed in a larger dish filled with water.

Apply hot as possible, with paint or white-wash brush.

The above is recommended as at once a good whitewash, or a cheap paint, that will last well.

Economical **Floor Paint**: "Two and one-eighth ounces of good, clear, joiners' glue is soaked over night in cold water, and, when dissolved, is added, while being stirred, to thickish milk of lime, heated to the boiling point, and prepared from one pound of quick lime. Into boiling lime is poured—the stirring being continued—as much linseed oil as becomes united, by means of saponification, with the lime, and when the oil no longer mixes there is no more poured in. If there happens to be too much oil added, it must be combined by the addition of some fresh lime paste—about half a pound of oil for the quantity of lime just named. After this white, thickish foundation paint has cooled, a color is added which is not affected by lime, and, in case of need, the paint is diluted with water, or by the addition of a mixture of lime water with some linseed oil. The substance penetrates into the wood and, it is said, renders it water-resisting."

A **Model Dairy Building.** The following is a description of a dairy of which the counterpart or model was built at Cornell University, New York. It was built to give practical instruction in dairying to students in agriculture, and intended to "embody in the building itself, the best principles of construction," and the construction of a building actually intended for farm dairy work—for practical farm dairy purposes. It is a model in every respect; in simplicity and cheapness, of easy construction, and of adaptability to intended purpose. All the material for walls and lower floor, except lime and cement, are usually to be found on the farm. Farm hands can do the mason-work and much, if not all, of the wood-work. It is a model which does credit to even so eminently good a model of a practical and scientific farmer as is Professor Roberts himself.

The striking merit of this dairy building has led the writer to devote all the time and space necessary to such a description of it as will be understood by any amateur builder interested. If it be not within the means or need of the reader, it may afford practical suggestion helpful in fitting up, or improving, dairy rooms, or even dairy cellars.

The wall, when finished, should be about one foot above the ground, and deep enough to be below the reach of frost. Having deep trenches for the wall, cover the bottom of the trench with a layer, about 6 inches thick, of cobble-stones; and fill the spaces between these stones with thin mortar. In this manner, build up the whole wall, layer by layer.

Having built the wall to the top of the trench, or to the surface of the ground, a temporary trench may be made of plank, in which to build the upper portion above the ground. The plank are secured by stakes, the whole to be removed when the wall has hardened.

The Floor will be a marked feature of this diary. It should incline from all parts of the foundation wall to a point at the middle of one end of the building. In other words, the sides and one end will be higher than the middle and the other end. Thus, along the middle of the floor, from end to end, is a *complete drainage* for the *whole floor surface.* The incline thus secured from the sides to the middle, and from the higher end to the point of drainage, should be steep enough to ensure easy drainage of the whole floor surface, without hindering the dairy operations.

The desired lay of the floor is given it by *grading the earth* to the required shape, or incline. The earth from the trenches may be used, in part or wholly, to raise the enclosed surface.

The Construction of Floor is somewhat similar to that of the walls. The floor is made of small, round field stones—cobble stones—any size, under say five pounds.

A layer about 6 inches thick of these stones is spread evenly over the whole surfece. These are solidified and partially embedded in the earth by throwing water upon them and then ramming them down so thoroughly that they will be perfectly secure from settling. A load of clean, coarse gravel is then spread over the surface, and the mass again rammed. *Very* thin mortar, same as used in building the foundation walls, is poured on the floor till all the interstices are filled, *but not enough to cover all the projecting stones.*

When the first coat of mortar has hardened, a second coat of mortar is made of *one* part of some good cement and *three* parts sand. The cement used may be Portland, German, Hull —as convenient. This second floor should be of sufficient thickness to make *an even and smooth surface.*

As soon as the second coat has hardened, a very light third and last coat may be applied, made of *one* part *best cement* and *one* part *best sand.* When done, the outside edges of the floor will rise about even with the top of foundation wall. Care must be taken, in building a floor of this character, to keep the floor, and ground beneath, from a flooding or pressure of water before the cement shall have hardened perfectly. A well-chosen site—that is, high location—will guard against this contingency.

Merit of Floor. Professor Roberts tells us that the floor thus made is perfect after six months' use, and bids fair to be as durable as the best of stone. "It is easily kept clean, and never has any of the combined smell of decaying wood and sour milk." Says Prof. Arnold: "The surface of this floor is very smooth and of rock-like hardness, making it easy to keep and be kept clean. Its connection with the ground gives it a low and even temperature, and secures against currents of foul air, and against frost and outside heat."

One of the advantages of the floor is the convenience of washing it, by simply flooding and mopping. Another is the saving of labor in churning-room or working-room; for instance in washing butter in the churn, or washing utensils, the wash is allowed to flow directly on the floor, when it will at once drain off and out.

The Frame is what is called a balloon frame, resting upon the grout wall which has been described. The sills are 4 × 6 inches, and are placed edgwise on the wall, within one inch of the outer edge of the wall. The several pieces are conveniently joined to each other by scarfing. The perpendicular frame-work is scantling, 2 × 4 inches, placed say 14 inches apart nailed to the sills, and secured at the top by a plate, 2 × 4 inches, spiked to their top ends, Thus the studs and sills are each 4 inches through, and are *flush with each other.* The studs for a two story dairy are conveniently about 16 feet long.

Making **Dead-Air Spaces.** Heavy building paper is now tacked *perpendicularly* to the *outside of the studding*, the paper *lapping*, or joining, at *every other studding.* For studding with two inch face, and set fourteen inches apart, the building paper ought to be 34 inches wide. The paper should extend from *top of the plate* to the *bottom of the sill;* and for 16 feet studding would need to be cut 16 feet 10 inches in length. Wooden strips—called furring—one inch thick and two inches wide, may now be nailed perpendicularly, directly upon the outer face of the upright scantling. These strips will add one inch to the thickness of the walls, and secure the paper firmly at every joint and every stud, and so serve the purpose intended, of preventing circulation of air. By nailing to the furring, or strips, ordinary clap-boards, or "lap-siding," the outside of the wall will be completed.

Now is wanted another course of building paper, or a course half-way between the outer edges of the studding. Cut strips of paper four inches longer than the studding, and 4 inches wider than the distance between the studding. Turn up at right angles two inches of the edge of these strips. It will now be like a box, say 16 feet long, 16 inches wide and 2 inches deep; and it will closely fit the space between the studs. Tack up these strips in these spaces, or half-way between the inner and outer edges of the studding, securing them by tightly nailing cleats, say plastering-lath, upon the turned-up edges. Cover the inside of the studding with paper just as the outside was covered, lapping the edges and nailing tight; also nail on inch furring, as before. The studding now will be 6 inches thick. Any suitable finishing boards, say spruce or pine, sound and narrow, and matched, may be nailed horizontally upon the inside furring, to make the inside finish of the walls. This will make the walls 8 inches thick composed of five coverings, enclosing 6 inches of spaces or four almost dead-air spaces.

The building will have **Two Stories**, and joists for the upper floor will be built to match the studding of the walls. The ceilings, the upper floor, the rafters, and the partitions and doors, dividing up the rooms below, will be constructed like the outer walls, except that no furring will be used, the matched boards being nailed to the joists, or studding, directly on the paper lining. In other words these parts will be built with three courses of paper and two of boards, the boards directly covering the outside paper.

The rafters may be raised so as to leave a space between the roof boards and plates, through which any heat from the roof may pass up into the garret and out through a ventilator there provided.

The ground room may be divided by a partition into a milk, butter, and work-room.

The former will be at the rear end, and where the floor is highest, and may be divided into two rooms if required, say one small room for storage.

The work-room, or churning-room, will be located at the other or the front end towards which the drainage runs. At the point of drainage, an outlet must be provided in the shape of a pipe or gutter, with incline enough and leading far enough away, to carry the wash-water out of range of influencing the atmosphere of the dairy. It may be carried to garden or field and serve for irrigation.

At Cornell for this purpose is used a vitrified earthenware pipe, which is six inches in diameter, and not found too large for the purpose. It is two rods in length and so arranged that it can be swabbed out and kept clean. A jet of steam from a small engine has been found enough to keep it clean. It may in ordinary practice be flushed with water. The upper room may be used for curing cheese for storage or like purposes, divided up according to need. The windows should be double and close-fitting, with provision for easy opening when required. It would be well to have some of the windows provided with shutters. Those of them intended to be opened should be provided, too, with moveable frames, or stretchers, of fine wire-gauze, to exclude flies and dust.

Painting. The inside of the building may be treated to a coat of oil and shellac, and the outside to two coats of white paint. At first oil or paint will give a taint to dairy products, but this has been found to disappear in time. Shellac will not give any such taint.

Cost. The Cornell University dairy building, of the above description, 16 × 26, two stories high, each divided into two rooms, the whole above ground, cost $500. The framing lumber cost only $15; while the dressed pine $36 per thousand. Spruce would have less of a wood odor than the pine, and cost in many localities less than half that price. At Cornell, farm hands working upon it were charged at $1.50; carpenters at $2.50; and teams, with drivers, at $3.50 per day. The cost of such a building, outside of one's own farm labor, in many cases, would be a comparatively small amount—even less than $100.

The temperature in the above dairy in summer is constantly about 60°, and in winter is maintained at same temperature without large expenditure of heat.

Says Professor Arnold of this dairy:—"With the windows close-fitted and double-glazed, this building is prepared to withstand changes of weather. Neither summer's heat, nor the winter's cold can make more than a faint impression upon five tight walls with four dead-air spaces between them, and the ups and downs of the season are not felt at all. This is just what is required in every **Cheese Factory and Creamery**, and a very important consideration in this little structure is that it is comparatively inexpensive. The floor and foundation walls are made of cheap material, and with unskilled labor, and paper, at a trifling cost, is made, simply by skilful arrangement, to do the chief work of protection above ground. The woodwork inside is simply varnished, giving it a neat look and making it easy to keep clean, and the outside is well and tastefully painted, making the structure in all respects a model of neatness, efficiency and economy."

There is one possible defect in the building above described. The writer is informed that building paper nailed across from studding to studding, bearing only on the studding, may after a few years tear off. The supposed reason is the swaying of the building. But one would think this could not happen if the building were solid and strong enough not to be swayed by the wind. Doubtless, it may be guarded against. The writer would suggest not stretching the paper too taut, say tacking it up with a slight crease, or fold; or, in any way that would leave the paper a little lax—not too tense. It is probable that the thick, hard, board-like building-paper now being manufactured, and inexpensive, would not be possibly torn or broken by the swaying of the building.

UTENSILS AND SUPPLIES. Butter-making is possible with the simplest and most primitive appliances. Butter has been made, and may be made again, by concussion in the skin of an animal. An animal gave the milk; an animal furnished the apparatus. Butter may be made with a bowl and a spoon; butter may be made with a few little old pans and an old fashioned dash-churn, with nothing else. Yet there are butter-makers who do not think their dairies properly equipped without a thermometer and all the apparatus that modern ingenuity has invented for the dairy. Whether it is wiser to continue in the use of primitive appliances, or to utilize the best of modern improvements, may be determined by the results of the different practices. This being true, it is enough to say that the most successful butter-makers adopt the best mechanical helps available. First are the Danes, who are, perhaps, more successful than all others. Says Prof. Sheldon:—"They study the principles of their art, which are propounded to them by scientific teachers, and they follow out the most approved systems, and adopt the most modern utensils."

Prof. Bell, speaking of the "marvellous advance" in cheese-making, attributes much to mechanical aids. He says: "The apparatus supplied now leaves little to be desired, furnishing a striking contrast with the past. I will instance the jacketed vat and the gang-press. The recent improvements, both in apparatus and methods, have the advantage over the dairymaids of former times that the disciplined force carrying the repeating rifle and revolver would have over a tumultuous mob armed with the javelin and bow and arrows of antiquity."

Butter-making is quite as much as cheese-making dependent upon mechanical helps, and the contrast between the practices is quite as striking in the butter as it is in the cheese dairies.

Miss Morley, the "Champion Butter-maker," of Wisconsin, is an example of the successful dairymaid of modern times. She says: "I do advocate a more thorough investigation of improved apparatus for butter-making, and a more enlightened knowledge of different methods than to many seem necessary."

It is quite unnecessary to take up limited space to support an argument that will be very generally admitted, with even less proof than has been given. It is allowed that there are persons who can make up in care and skill for lack of appliances, but it must be claimed that even these individuals will find great help and profit in the help of better appliances; and as to the many who lack the superior skill, it is only by the help of suitable appliances that they can hope to attain any good result.

The advantages to be found in the use of a single instrument—the thermometer—have only to be hinted at to be generally appreciated. The change that has come in the wake of the introduction of the sewing-machine is an illustration of the possible advantages to be found in the introduction of improved dairy utensils. The difference between old-time butter-making and scientific butter-making, is much like the difference between sewing by hand in the old days and sewing with the wonderful modern machine. The change made in one case shows the change possible in the other. The means of improvement in one case may be the means of improvement in the other case—mechanical aids.

There are some **Points of Merit** that are common to various dairy utensils. They are: *First*—Adaptability to the object intended. *Second*—Simplicity of construction and working. *Third*—Working easily. *Fourth*—Washing easily. *Fifth*—Cheapness. *Sixth*—Durability.

Some of the precautions against impurities, suggested by the conveniences such as we are about to illustrate, may seem like making too much of trifles. But it is attention to just such trifles that has marked the highest success in dairy practice. The Darlingtons have made a world-wide reputation for production of fancy butter, which has supplied the tables of presidents and ex-presidents of the United States, and of millionaires. The stable and hog-pen at the Darlington farm, are out of the sight and smelling range of the dairy. The milkers are not allowed to enter the dairy-house, carrying in their clothes the odors of the stable. Yet the Darlingtons are not "gentlemen farmers," they are working farmers, whose system of management is within the scope of other intelligent and progressive farmers.

Even admitting that it is not practicable for every farmer to attain to that degree of nicety in his dairy operations which characterizes the makers of gilt-edged butter, he may easily adopt a few simple precautions that will reasonably guard against every offence to the sense of that cleanliness to which alone he may owe a *possible* market for a *high-priced* luxury—fine-flavored, delicious-tasting butter. Such precautions are very necessary in the care of the milk from the stables to the dairy; for here lie many chances of doing lasting injury to the product, by sheer negligence, or by failing to adopt some simple precaution to guard against the risks to which milk is so liable.

Dairy Thermometers are very little different from ordinary thermometers. They should be constructed in a way to be easily washed and not easily broken. They do not indicate so wide a range of temperature, and consequently have wider spaces, making them easier to readclosely. Where one cannot procure a dairy thermometer, the next thing to do is to buy an ordinary weather thermometer, which can be had at almost any village store. The prices of ordinary thermometers range from 25 cents to one dollar each. The commonest one to be had may be made to serve the needed purpose, provided that it be *true*. It should be borne in mindhowever, that the common thermometers are frequently *very inaccurate*, and that little dependence should be placed upon them before they have been tested.

To Test Thermometers. Find a thermometer in the vicinity which is known to be accurate, and compare the one to be tested with it. In comparing the two, it is better to insert the bulbs of both in water—in the same dish—and note the difference, if any. If one cannot be found of known reliability, there is still another plan. Take several of the thermometers of the stock in hand at the store when making a selection, and insert them all in a dish of water. If several of them indicate exactly the same temperature of water, one of these may be selected with considerable certainty that it will be correct. It is a reasonable presumption that if two or more of them agree closely they are likely to be correct. If one desires to test a thermometer already in one's possession, it may be compared with those of one's neighbors. Even an imperfect thermometer need not be useless. Having found to what extent it is astray, allowance may be made for the difference. For instance, if a thermometer reads three degrees too low, always add three degrees to its reading. If in such case it reads 59°, call the temperature 62°.

A new thermometer is more or less subject to gradual change for some time. After two or three years use, however, it becomes fixed. A thermometer should be tested, therefore, occasionally in the first years of its use; and great care should be taken not to lose a good one by breakage. An old thermometer, that is still in good condition, and reliable, is an instrument to be carefully prized in dairy work.

It is a good plan to buy two or more inexpensive thermometers at the same time; that they may serve to check each other, and supply the need in case of breakage.

There are **Three Systems** of noting degrees of temperature, called respectively **Fahrenheit**, Centigrade (or Celsius), and Réaumur. The one is indicated by the letter *F*, as 50°*F*., one by the letter *C*, as 10°*C*., and the other by *Réau*, as 8°*Réau*. Where no letter is given after the number of degrees, it is understood to be the system in vogue where one is writing. The system common in America and Great Britain is Fahrenheit, and will be the one used in this book.

Since in general reading one may find the use of a system foreign to that in common use in one's own country, the following **Table** showing the relation of the three scales of the degrees of temperature most used in dairying, will be found convenient for reference :—

TEMPERATURE.	FAHT. =	CENT. =	RÉAU.
Water Boils	212° =	100° =	80°
Scalding	150	65.5	52.4
Milk Heating................	140	60	48
Milk Warming	104	40	32
New Milk	98	36.7	29.3
Cheese-Making	84	28.9	23.1
Churning	60	15.5	12.4
Packing	59	15	12
Washing Granular Butter...	55 (and below)	12.1	10.2
Milk Cooling	45	7.2	5.8
Freezing	**32**	**0**	**0**
Below Zero, C. and R.......	23	–5	–4
„ „	0	–17.8	–14.2
„ F., C. and R....	–4	–20	–16

To convert Centigrade degrees into Fahrenheit degrees : *Multiply the number of degrees by $\frac{9}{5}$ (or 1 8), and add 32 to the product.* Examples : **15° C.** (× 1.8 = 27 + 32) = **59 F.** Or, – **20°C.** (× 1.8 = – 36 + 32 =) – **4° F.** To convert Réaumur to Faht. : *Multiply by $2\frac{1}{4}$, and add 32.* Examples : **12° R.** (× $2\frac{1}{4}$ = 27 + 32) = **59 F.** Or, – **16 R.** (× $2\frac{1}{4}$ = – 36 + 32) = – **4 F.** To convert Fahrenheit to Centigrade or Réaumur: *Subtract 32 from the number of degrees, and multiply by $\frac{5}{9}$ for Centigrade, and $\frac{4}{9}$ for Réaumur.* Examples : **212° F.** (– 32 = 180 × $\frac{5}{9}$) = **100° C.** Or, – **4° F.** (– 32 = – 36 × $\frac{4}{9}$) = – **16° R.** Care must be taken to note the minus sign when used, for a failure to do so will result in error.

Milking Pails. If there is any one thing of more importance than all else in dairying, it is cleanliness ; if there is any one thing that has most characterised the operation of milking, it is filthiness ! The ordinary practice has been to milk in large-mouthed open pails, sometimes without making the slightest pretence to cleaning the stable, cow or udder. After the milk has been drawn, the pail is perhaps set down in the dirt, near at hand, there to stand until all the cows have been milked, for the milk to catch dust, and, as it cools, to absorb odors. After the flat bottoms of the pails and the soles of the boots of milkers, and even clothes, are more or less daubed with dirt, the milk is carried to the dairy to be strained.

In straining, the milk is perhaps poured forcefully through a cloth or seive, that catches the little dirt that cannot get through the meshes, which dirt as it accumulates on the strainer becomes pretty well washed by the swift stream of warm milk, of whatever impurities it contained ! If choice were to be made between the impurities in the milk and the impurities lying on the strainer out of it, very often the latter might be preferred as the least offensive ! Yet from the force of habit, the drinking of milk unstrained, however carefully it may have been milked, would be thought something reckless ; but after it has passed the magic strainer, we are supposed to drink that same milk with quiet complacency ! It seems somewhat strange that so manifestly imperfect an operation should so long continue without being modified by some improvement in practice, or in mechanical aids, more general than has marked this age of progress. We do read of a practice in the Channel Islands, the home of the Alderney and the Jersey, that is not so open to the objections made to the plan generally in vogue elsewhere. *Milking and straining are done at one operation.* The strainer is tied securely over the narrow-mouthed bucket, and a large, shallow shell is placed on the strainer. The stream of milk is directed into the shell, where its force is spent, and it gently overflows and falls upon and through the strainer, into the closed pail ! What a contrast to the plan of allowing the dirt to fall in, mix, soak and stay in the milk ! There is something cumbersome about the practice just described, but that is a fault which ought easily to be remedied, and it possesses a virtue far exceeding its little fault.

Within a few years, milking pails have been introduced, which possess great merit in this direction of improvement, and it is to be hoped that the old way even yet so common, will soon become a thing of the past. These pails being recent inventions are generally patented articles, and so cannot be noticed in this MANUAL, which for obvious reasons excludes everything of a proprietary character ; but every dairyman should either himself contrive some way to secure the desired result of cleanliness, or procure some one of the various improved, or *strainer-milking* pails in the market.

The main points to be kept in mind in procuring a milking-pail are the following : A milking-pail should effectually protect the milk from any contact with impurities of the surroundings ; it should ensure the earliest, speediest and most effectual straining of the milk that is possible ; and it should be plain, cheap and durable. A rim bottom is to be preferred to a flat bottom, as it will catch and hold less dirt. Wooden buckets should not be used for milking-pails, at least until some way shall have been found to render the pores of the wood impervious to liquids.

A Milk-Carrying Can. There are some advantages in the use of a vessel specially adapted for the carrying of milk, and the straining of the milk directly into such vessel. This plan ensures an earlier straining of the milk, thus shortening the time that any dirt which falls in the milk will remain in it soaking. It will also allow of the quicker removal of the milk from the milking-place to a purer atmosphere, where it can be aerated while being strained. Or, if it cannot be far enough removed from the place of milking to find a purer atmosphere, a carrying-can will at least keep the milk closed from the air and dust.

Another advantage is the convenience of carrying larger quantities of milk to the dairy, without slopping; and a still greater one in providing against the objectionable practice of carrying into the dairy the milking-pails that have been *set down on the floor of the stable.* This last is important. The milking-pails are liable to be set in the dirt; but a carrying-can may always be set one side, upon a board, a box or a bench.

A convenient-sized carrying-can would be one 10 inches in diameter by 15 inches high—up to the shoulder, holding about 60 pounds, or 6 gallons, imperial measure. Strong bottoms of pressed tin can be purchased from dealers in pressed tin supplies.

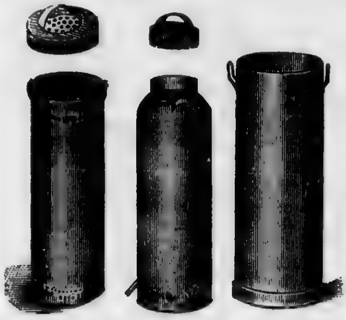
Milk-Setting Vessels. Small open vessels have been largely used in the past, and are in quite common use to-day. They have their points of merit and their disadvantages. The best of this sort of milk-vessel is the modern seamless pan. It is cheap, light, and easily cleaned.

Within the past few years has been introduced a new system of milk-setting, or the use of larger-sized vessels, adapted for holding larger quantities of milk, and for cooling the milk by means of water or ice. These milk-setting vessels are called *creamers.* Whatever may be the respective merit of different creamers already in the market, they all, or nearly all, possess at least one advantage over the pans. They are certainly labor-saving implements. There are farmers now using creamers which they claim have not the merits of the old-fashioned pan, except in this one point of saving labor. This seems enough to ensure their use, in some cases, in spite of claimed defects that make them in some respects inferior to the small open pans. The creamer is a deservedly popular milk-vessel.

The little open pans that have so long and well served the need of the dairymen evidently do not fully meet the wants of the dairymen of to-day. By having larger-sized vessels and fewer of them the objects are attained, at least, of less labor, more convenience and greater cleanliness, and perhaps less cost.

Some dairymen find it convenient and economical to employ both the shallow and deep-setting systems. The former, for instance, is perhaps found more advantageous during the hot summer; and the latter system in fall and winter.

Creamers may be so constructed that a creaming dipper may be wholly dispensed with. The creamer is provided with a glass through which the cream is visible, and a fawcet or a plug outlet for drawing off the milk. There is usually a distinct line of separation between the cream and the milk, which serves a guide in the separation. When ready to skim, the outlet is opened and the skim-milk allowed to run into a milk vessel. A cream vessel is close at hand, and when the milk is nearly all out this cream vessel is quickly substituted for the milk vessel, and the cream allowed to flow into it.



Sometimes the outlet is closed when the milk has run off, and the cream is then poured out from the top.

Our illustrations show the plain sorts of creamers which any tinsmith may construct.

The covers of the creamers illustrated, it will be noticed, are provided with wire-cloth ventilators, under the handles. The flange of the cover for the open-mouthed can fits inside, that for the narrow-necked can on the outside. On the can itself either a handle or a bail may be used. Where the can has to be lifted high, the handle will be the better. The dotted lines show the bottom of the can.

The size of these creamers may vary from 6 to 8 inches in diameter, and from 18 to 22 inches in depth.

Where no ice is used, and where dependence is placed upon water of a somewhat high temperature, say above fifty degrees, the smaller diameter is likely to give the best results, especially in the summer months. The cost of these plain creamers, well made with good tin, would run from 75 cents to $1.50; according to the style of the creamer and the cheapness of the tinsmith's labor, which varies greatly in different localities.

Another style of creamer is the oval. These are much used in Europe, and are generally known as the Swartz system. They are used usually with tanks sunk in the floor, and with ice. They are made from 17 to 27 inches high; 15½ to 20 inches long, and 5½ to 7 inches wide; holding from 40 to 65 lbs. milk. The smaller and narrower creamers will usually be the most effective; for instance, one 5½ inches wide, 15½ inches long, and 21 inches high, holding 50 lbs. For small dairies where the dairy outfit is not elaborate, and especially without ice, the round creamers before referred to are always preferable.

The Strainers shown in illustration are of different styles, that one may choose to suit the need of the dairy. They may be made to fit the creamers, or to fit the milk-carrying vessel. The one standing on legs might be used to strain either new milk, cream, or butter-milk, were it not that the two latter would be full better with a somewhat larger mesh than is required for new milk. It is an excellent plan to use a double strainer—one of both wire and cloth. The cloth is spread over the flange below the wire strainer, and held by a hoop which telescopes the flange.

Cream Scoop.

Deep-Setting Cream Dippers.

Cream-Dippers are cheap conveniences. For shallow-setting, a small scoop is best; shaped like the old-fashioned skimmer, but without any holes. For deep-setting, a good skimmer will be found in the long-handled dipper, shaped like an inverted cone.

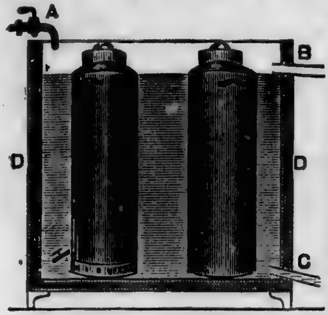
Any tinsmith can make these simple dishes. It is required only that the edge be thin and sharp; that is, not turned over, or doubled. The edge of such dippers is usually left raw (of single thickness) but quite smooth; which allows the thick cream to flow into the dish more freely.

Convenient sizes: For the scoop, 5¼ inches, greatest width; 6 inches in length; depth, ¾ inch. For the dipper, breadth at top, 3 to 4 inches; depth, 4 to 5 inches, coming to a point below; length of turned handle, about 10 inches, that of straight handle, about 20 inches.

Little practice is required in the use of these cream-dippers to make a very thorough skimming of the cream. By their use the milk is skimmed from the top, thus obtaining cream free from sediment.

European Cream-Dippers, used to some extent in England, are sometimes made of enamelled iron. It is doubtful if they are better than the simple and cheap tin dippers just described.

Tanks. In shallow-setting, the milk is usually set in air in a cool room, not above 60°. In deep-setting, milk must be set in water. This makes necessary a tank or reservoir for water or water and ice. The simplest method is a natural well, or spring, in a shaded, cool place. Sometimes a pool is easily made, say for running water, which, by constant change, will be always cold. A barrel is sometimes made to serve the purpose, and when it stands in a cool place, and the water is cold, and can be several times changed, it will do for small quantities of milk. A wooden tank need not be very expensive. It should be constructed with a view to prevent the warming of the water by the outside air; with smooth, watertight walls for retaining water and for easy cleaning; and with an inflow an overflow, and an outflow, for water. It should be made with double walls and bottom, with a space of 2 to 4 inches, which may be filled with charcoal. The inner walls, or the reservoir itself must be made tight, so that it will not leak or get damp. It is possible to do this with paint or varnish, but not easy. It is better, and not very expensive, to line with zinc. Where there is abundance of cold water, or ice, and a cold room, so that the cooling of the milk will not be retarded by the effect of the warm air, the double walls and charcoal filling may be dispensed with;—the single-walled tank, lined with zinc, or even varnished, being sufficient. In the European Swartz system, the tanks are made of slate, brick, stone, or cement, and sunk almost wholly below the surface of the dairy floor, or ground. There should be a least 5 inches of clear space between each can, and the cans and walls of tank.



A. Inflow. B. Overflow. C. Outflow (for draining off water to renew tank). D. Charcoal filling.

Cream-Holding Vessel. Since there is a loss in churning different lots of cream that have stood in different vessels and ripened unequally, it follows that all the cream of any churning should have been kept for some hours at least well mixed in one vessel. To do this it is necessary to have a cream-holder large enough to hold all the cream of each churning, or, in other words, a cream-holder with the full capacity of the churn. This is an important matter, and will hardly be ignored by the thrifty butter-maker unless he should be ignorant of the percentage of loss that may come of keeping cream of different ages in separate vessels.

A point of merit in a cream-holder will be its adaptation to heating or cooling the cream by setting the holder itself into hot or cold water. Tin seems best to meet this requirement, and tin has the merit of being light, easily cleansed, and cheap.

CHURNS. Churning is one of the most important of dairy processes. At one time churning was all there was of butter-making; it is a process even now absolutely necessary. It has been the most laborious and unpleasant part of butter-making; it now may be made an agreeable and easy part of the work. Churning has been the means of spoiling millions of pounds of butter; it has now been reduced to a science, and to do it properly and well is to do a large part towards the production of the real "gilt edged."

Churning is a process that almost more than any other in butter-making depends for being well done upon the implement used. A person who is intelligent and skilful may milk in an open pail, set milk in an open pan, keep cream in a common house jar, press and salt butter with a ladle in a bowl, and be able to pack a fine article. But there are some churns which, though manipulated most skilfully, will completely spoil the product. Harris Lewis says that the churn which brings butter ordinarily in five minutes has ruined the butter in two and a half minutes—*before the process is half done!*

There have been many erroneous ideas about churns, and dairymen have bought churn after churn only to throw them aside, and to come back to the "old dash-churn." This has led to a very common claim that the old dash-churn could not be improved upon. Yet the very fact that so many churns have been invented, sold, bought and tried, is a proof that the old stand-by was not perfectly satisfactory. That it has its defects may easily be seen. It is admittedly hard to operate; churning and turning grindstone have ground out in many young breasts all enthusiasm for the farm. It is not well adapted for washing the butter in the granular form; and this process, in importance, is second to no other in butter-making.

It was not strange that prejudices arose against new churns. The patent office records will explain such prejudices. So does the unhappy experience of thousands of farmers, who, tempted by the alluring promise of each new churn, were led to buy in many cases only to set aside a worthless thing that carried in its track only disappointment.

There is no further need, however, either for clinging, on the one hand, to the old dash-churn, as though it were perfection; nor, on the other hand, of being more in dread of a churn agent than of a tramp. Dairy science has advanced enough now to prove that the old dash-churn, unlike the violin, can be improved upon, and to demonstrate wherein lie the defects or merits of a churn, so that one ought to be able to select one with the same confidence that he would buy a mowing machine.

Churns may be divided into two general classes: First, are movable bodies with fixed dashers, or without dashers. Second, are those with stationary bodies, and movable dashers. It will be found that with one exception the second class of churns are, in all the points given, except one, inferior to those of the first class.

Churns of the second class mentioned are not worthless, but more or less faulty and inferior. Some of them are, indeed, worse than useless, but others of them possess fair merit. The ones which stand best are those which come nearest to the cylindrical form, and have the simplest system of dashers.

Churns of the first class may be divided into two sub-classes, namely: revolving churns and oscillating churns. Each sort has its advantage and disadvantage. The disadvantages of the revolving churn are the difficulty of making a tight cover, also the difficulty of ventilation. Where they are not properly ventilated they require a greater diameter.

The revolving churn, without dashers—fixed or movable, to be at its best should be provided with ventilation, or for escape of gas; its diameter should be small enough to make it easy to work; its cover should be a convenient and tight-fitting one, and it should be provided with a convenient strainer for drawing off the butter-milk, and washing the butter. This done there is little improvement to be made in it.

The oscillating churn has one advantage over the revolving churn; its opening being always on the upper side, the cover is easily fitted on. It has the disadvantage of being harder to operate than the revolving churn, and in some cases seems to agitate the cream too much and to bring the butter too quickly. It is best suited for small dairies, and the best of them doubtless may be operated so as not to injure the grain.

Points of Merit in a Churn are: *First.* The agitation should be of such a character that the cream is churned by *concussion rather than friction.* One would suppose that the fat globule, protected for the time being in a liquid, would stand agitation of any sort; but when we remember that one churn will bring the butter in five minutes which would not come in thirty minutes in another churn, we can conceive of it being possible to over-agitate cream in churning.

Whatever may be the effect at the beginning of churning, it is without question that when cream begins to "break" and butter to "form," the character of the agitation may be such as to injure the grain of the butter. It is the experience of butter-makers that some churns destroy the grain and make the butter greasy.

Another question is settled. It is not the slow churns which injure the grain of butter but the quick churns. The slow churns are the churns without inside fixtures; the quick churns are the churns with dashers.

Second. A churn should give cream **Uniform Agitation.** The cream should be churned all alike and the butter come as near as possible at the same time. This is important for quantity as well as quality of butter. When all the cream is agitated alike, more of the cream is churned without some of it being over-churned. When butter all comes at the same time there is less waste of butter in butter-milk in draining or washing. The churn which meets this condition is again, a churn without dashers—especially a revolving churn.

Third. It is required that the churn be **Adapted to the Granular Process** of churning. It is *possible* to make and wash granular butter with any churn. It may be done even with a dasher churn; but to do it requires considerable skill, absolutely demands a lower temperature of the butter in washing, and calls more for other mechanical helps, such as milk or water vessels, strainers, etc. Churns without dashers will do this work in the simplest, easiest manner possible. The movable-body feature of such churns is especially adapted to this requirement.

Fourth. There should be **No Waste of Cream.** The waste of cream in some churns is a direct loss and it is usually uncleanly, or, in other words, undairylike. Cream grinding between two hard surfaces, as between shafts and bearings, is not only a waste but makes the butter greasy. Cream constantly slopping out of the churn, and on the cover, not only is less uniformly agitated but it is more or less wasted. The movable-body churn is preferable, for if properly constructed there is neither grinding nor loss of cream.

Fifth. **Ease of Working** is a very important essential in a churn. It was the hard work of churning that brought into favor the quick churns that have spoiled so much butter. The movable-body churns are doubtless the easier churns to work of the two classes.

Among these the revolving churn, if rightly constructed, is easier than the oscillating churn, especially for large quantities.

Prof. Arnold, in "American Dairying," showed that the better the old dash churn was constructed for good work, the harder it was to operate. This is not true of the revolving churn. It would seem that the construction of the revolving churn with a view to making it easy to operate is the very best construction to ensure good work! Such construction means slower churning perhaps; but slower churning, as a rule, means better butter, and it certainly means better butter in this case.

The revolving churn, to be at its best, should be so constructed as to bring the lift as near as possible to the centre. This is done by making the diameter of the revolution as small as possible. The less the diameter, up to a certain point, the longer will it take to bring the butter, but the easier will be the working. The diameter requires to be from about one foot, for small sizes, up to about two feet for a good-sized dairy churn.

Perhaps the two best forms of revolving churn are the *box* churn and the *barrel* churn. The box should be made of rectangular form and oblong, with the bearings at the middle of each end, and revolved, of course, horizontally. The barrel churn is made preferably to revolve end-over-end; and, to secure the necessary small diameter without sacrifice of size, may be made *larger in diameter than in length, inside.*

Patents on churns do not cover these excellent features, so one may buy or make, according to his choice, unless one has a preference for some particular convenience which is patented.

Sixth. **Ventilation** is essential in a churn. When cream is first subjected to agitation, especially if it be at all sour, it evolves gas. This gas should be allowed to escape; both for sake of easy churning and quality of butter. With the old dash churn the ventilation was easy—through a loose and open cover. The revolving churn, which bears off the palm in perhaps all other respects, is the weakest of all at this point. To prevent loss of cream it must needs be well closed up. It is necessary, when using a revolving churn, when not otherwise provided for, to stop occasionally, pull out the stopple or plug and let the gas escape. This is done frequently in the beginning of the process. Afterwards it is not so necessary. Some churns have patented arrangements for this purpose; but these features must be left to the circulars of manufacturers.

Seventh. **Easy to keep Clean** is a very important requisite in churns. It ought not to be necessary to enlarge here upon the need of absolute cleanliness in butter-making. It is at once one of the most difficult and necessary attainments in dairy-work to become proficient in neatness and cleanliness. It is well then to have implements that are easy cleaned, for often this is their only chance of being kept clean. The churn easiest to clean, by far, is the churn without inside fixtures—the revolving or oscillating churn.

Eighth. There are a few **General Points of Merit**, that will be always in one's mind in making choice of most any implement. They are simplicity and durability of construction, lightness and portability, and reasonable cheapness. Nearly all the churns in the market possess these merits. The cost of a good buggy or a good mowing-machine is perhaps ten times the cost of a good churn.

The Best Churn Not New. The revolving churn is an old churn; it was used and well liked over a quarter of a century ago. Mr. Flint, writing in his standard book, published so long ago as 1860, and quoted even yet, says: "It is the concussion, rather than the motion, which serves to bring the butter. This may be produced in the simple square box as well as by the dasher churn; and it is the opinion of a scientific gentleman, with whom I have conversed on the subject, that the perfect square is the best form of the churn ever invented. The cream or milk in this churn has a peculiar compound motion, and the concussion on the corners and right-angled sides is very great, and causes the butter to come as rapidly as it is judicious to have it. No dasher is required. If anyone is inclined to doubt the superiority of this form over all others he can easily try it and satisfy himself. It costs but little."

It may be asked how it is, while there was known a churn which is so near an approach to perfection, so many worthless patent churns could have been sold? There are several reasons. The revolving churn embodied the right principle, but it had minor defects that have only within a comparatively short time been remedied. It had not been generally introduced. Without the modern improvements it has been constantly growing in favor, and is being more and more extensively used. Lastly, it was not popularly known that a churn without dashers was a churn upon a right principle. And in this connection it will be well to note how it came about that so many churns were made upon a wrong principle, sold, and, for a time, used. If we see wherein mistakes have been already made, we are better able to avoid mistakes in the future. The difficulties in churning in the past, that made churning unsatisfactory, were often supposed to lie in the churn, when they were in something else. The old way was faulty in not having regard for the condition of the cream, its temperature, or the capacity of the churn. As a result, the length of time required to bring the butter, and the butter itself, was variable, in quality and quantity. This was all attributed to the churn. The greatest fault of the old churn—that of being too hard to operate—added to its supposed faults, condemned it, and made dairymen look for something better. Its peculiar merit, or the merit of saving the grain and producing good butter, was not fully appreciated; the operator at one time had no notion that grain in butter was of any importance. Taking into account the real and fancied faults of the churn, and having no idea of what were the actual requisites of such an article, the inventor came forward with a view to help matters. His reasoning was simple; it takes so long to bring butter with the old churn, and the work is so hard, something is required that will bring butter at least quicker, and if possible, easier. Here was the rock upon which the hundreds of "patent churns" split, and which ground to grease half the butter of a generation. It was in this way that the country became flooded with egg-beaters and threshing-machines for agitating cream.

To the foregoing the following clipping is pertinent:—

"THE BEST CHURN.—Mr. James Gray, of Edwards County, has a churn nearly like the one his father used when he was a child, fifty years ago. It is one of the most simple churns imaginable in construction, and it does its work perfectly. There are no inside fixtures to get out of order, but it is a simple box two feet long and fourteen inches wide, while each of the square ends has a block of hard wood screwed on to the outside center in which is fastened a gudgeon on which the box revolves. The cream is put inside of the box and at each revolution travels eight feet, constantly rolling, and at the same time gets four times broken up by falling to the lower side. These churns are easiest to keep in order, easiest to wash, and there is no royalty as they are not patented; any good carpenter can make one. I wish the dairymen of Pawnee county to think of this matter, for if it is worth while to make butter at all it is worth making well, and also we want all the butter the cream contains and with as little labor as possible. I am using one of these box churns. My little girl—not yet four years old—turns it because she likes to, and my wife would not exchange it for all the other churns she ever used combined."

The above at once shows the age of the revolving sort of churns, some of the defects in their early construction; and their merits, which they possess in spite of such defects. Up to a late day it was supposed that the large diameter of two feet, as above, was necessary to the churning of the cream. Later experience has shown that from one foot to 18 inches is enough for the diameter, or fall of the cream. The square box, or the end-over-end barrel of that diameter will do good work and be *easy* to revolve.

Size of Churn required. In buying a new churn, get one too large, rather than too small, or one that will not be over-filled when the churning is large.

Best Material for Churns. Wood seems to be the best material for churns. Tin which is best for many dairy implements is faulty for churns. Tin is too rapid a conductor of heat. The wood used for churns is pine, spruce, oak, butternut, &c. The softer woods have the advantage that they are easily constructed so as not to leak, and they are light. Churns of various kinds of wood have been used with great satisfaction. It must be remembered, however, that the churn is *not* an everyday *cream-holder*, for if it were, there would be an insuperable objection to wood.

Granular-Butter Holder. Where dairies are small and churnings are as frequent as they ought to be, the practice may be followed, as explained already, of accumulating several churnings, to be pressed and salted at one time. To follow out this practice, a vessel is required in which the granular butter of the different churnings may be kept together. A good strong barrel, with a close-fitting cover, will serve the purpose. Something must be provided to place on the top of the butter, to press it down, allowing the brine to rise over it, to keep the butter from being exposed to the air. This is because the butter is so much lighter than the brine. If not weighed down it would be constantly exposed. Something perforated, with holes too small to allow the butter to pass through, would be the thing required. One thing more would be a convenience, if not absolutely necessary. It is a hole at the bottom and a plug. The plug removed, a strainer could be inserted, the brine drawn off, the butter washed, and the water drawn off in a similar way. Without this convenience the butter may be dipped out with a seive-dipper, and washed or rinsed upon the butter-press.

Butter in the granular form may be put into muslin bags and then kept in brine in a butter-holder. Or, the holder would be useful to hold rolls of butter, wrapped in suitable cloths.

Butter Press or "Worker." Hand-contact with butter is objectionable as injurious to the butter itself, and because working butter by hand will injure the operator who is in delicate health. Hand-contact may easily be avoided by the use of a "butter-worker," which will also enable one to do the work easier, more quickly and in every respect better. This instrument is adapted to the work of pressing out butter-milk, water, or brine; working in salt, and even-mixing the butter to make one or more samples of butter uniform. There are various "butter-workers" in the market, and most of them possess merit.

The main requirement in a butter-press, besides the essentials common to most utensils in dairy use, is the adaptability for completely and speedily freeing the butter from water, making the butter solid, and evenly mixing in the salt, and doing this without *injuring the grain*, or requiring an undue expenditure of labour. It should be made of hard-wood, that it may easily be cleaned and kept clean, and it should not be expensive.

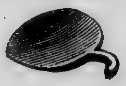
The most common and the cheapest butter-press, and one possessing a good deal of merit, is the table and lever, which being common property, may be constructed by anyone who finds it cheaper to make than to buy. Prof. Arnold describes the construction of one. The table is made of two-inch hardwood plank, birch, maple or white oak. The sizes range from three to six feet in length, two to four feet wide at one end, and half the width at the smaller end. It stands on either three or four legs, and inclines towards the narrow end, so as to drain off the liquid as it is worked out of the butter. A hollow groove on either side of the table guides the liquid down the incline to a point and into a pail. A loosely-fitting standard sets in a hole at the middle of the lower end of the plank, resting upon a shoulder, and fastened in place by a pin through the end, which reaches down below the plank. Through a hole in this standard one end of the lever is inserted, and the other is handled by the operator. The lever would be from two to four inches through and may be round, square, octagonal, three-cornered, or flat on one side and round on the other, or it may be fluted.

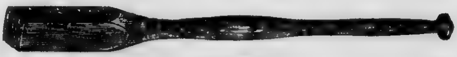
It is worked by a direct downward pressure upon the butter, rather than by a grinding or rolling pressure. The more advanced scientific process will in time do away with the general usefulness of this instrument; but wherever butter is "worked" it has a place to fill.

Butter Moulds. Among our illustrations (page 37) will be found a convenient hand-mould for shaping butter in cylindrical rolls, as described under "packing." It is made double, upon the principle of a pair of shears. The illustration makes the construction sufficiently plain. A good blacksmith can make the metal part, and anyone accustomed to working in wood can do the rest. The cost may be from one to two dollars. The small hand-moulds that have long been in common use, by which table prints have been made, are a most convenient article for every dairyman who wishes to put up butter in the form of table prints. When delivery direct to the consumer is possible, it is well to adopt some design that will distinguish one's own butter from all other butter.

Moulds, Prints, &c., for making butter into table shapes, are cheaper purchased than made at home. See that they are made of suitable wood, say white-wood, free from knots and cracks, and that the surfaces are smooth, to allow the butter to come out easily and maintain its proper shape.

For table prints, do not get too large a mould. Small prints in handling keep their shape better, and they are more popular with buyers. A half-pound print of butter is as large as ever required. A neat quarter-pound print will generally sell the best of all. Plain, cylindrical rolls may be made of larger size than fancy prints; they handle easily, and may be sliced off for table use. Owing to their compact shape, they handle and pack easily without getting out of shape.





Butter Packer.

Packing Pestles, Scoops, &c., may be bought of dealers in dairy supplies; or may be made to order by any wood-worker.

The Package. The most common form of package, or one that has best held its own so far, is that already referred to as the Welch tub. The almost universal use of that form of package on this side of the water is proof that it has merit. It certainly has some defects, to one of which allusion has been made—the lack of a water-tight cover.

The following are the **Points of Merit** in a butter tub: *First.* The tub should be of **Best Quality.** This is important; it is not economy to save a few cents on the tub at the expense of quality. When the tub is inferior, either as to quality of protecting or quality of preserving the butter, or as to appearance, there will be more discount on the butter than will be saved on the tub. One could hardly save on the cost of the tub more than one-half cent per pound of butter, and the defects of the tub might make the butter sell for say from one to five cents or ten cents less than it would have sold for had it been better packed and better preserved in a better tub. Not only may there be a loss per pound from a defective package and packing, but the butter may be actually unsaleable at any price.

Second. The tub should be **New.** Until tubs are made of a different sort from what are yet in the market they are unsuitable for repeated use. Butter should not be packed in an old tub. Could it be got for nothing, it would be a losing policy to use a tub the second time in which to pack butter. The appearance alone is enough to discount the butter more than enough to cover cost of a new tub. Old tubs cannot be got for nothing, as they are always of some value for other uses; so there is no reason, for the supposed slight saving between the cost of new and old tubs, for using any but a good and new tub. Good machine-made tubs of excellent quality are common and low-priced, making it less an object to use an inferior article.

Third. The tub should be **Light in Weight** and have a **Neat Appearance**. The weight affects the appearance, but the advantage of a light tub is mainly that it makes easier handling and a saving in freight. More regard should be had to appearance. Men judge even eating quality through the eye. If it were not for that reason butter-color, which if good is necessarily tasteless, would find no market. The imagination has more to do with our judgment than we at all times are ready to admit. When one looks upon a fair outside, he is ready to find the inside good enough to warrant the pleasing appearance. When the outside is not pleasing, there is a natural want of expectation of a good inside. From this fact it follows that, while a fair exterior will augment the value of what is within, even though it be of indifferent quality, a poor outside is unpromising and will depreciate the value of what is contained inside, even though it is of excellent quality.

It may seem unnecessary to philosophise to this extent on the appearance of butter tubs, but the practical bearing of the subject will warrant all that can be said that will lead the butter-maker to be wise in this matter. While a good appearance is a commercial necessity, it is a fact not to be gainsaid that butter-makers do not all look upon it as a matter of dollars and cents, unless it be in the way of saving a few cents in the cost of the tub. The butter-maker is too likely to look upon the cost of the tub as so much thrown away. This is because he has paid for the tub and is paid only for his butter, having to "throw in" the tub. It is not strange that this need of doing would lead sometimes to a short-sighted policy, and a policy so short-sighted that the importance of a better policy should be emphasized.

Fourth. The Form of the tub should be to make it easy to turn out the butter for examination, or for the purpose of getting its net weight. What is called the Welch tub is becoming the most common in use, and is likely to be the form of the tub of the future.

Fifth. The tub should be made of the **Right Kind of Wood.** A wood that is strong, light and tasteless, and can be made impervious to air, and brine-proof, is suitable for butter packages. Balsam, white spruce, white ash white oak and even hemlock, are good wood for tubs. The gummy part of spruce or balsam and the soft part of ash, should be thrown out. Inventive skill may yet give a substitute for wood; something light, strong and cheap, and possessing a polished inner surface that will not soak in brine or fat. Or it may yet give a coating to wood that will make it all it should be.

Sixth. The tub should have a **Water-Tight Cover.** It cannot be said that tubs with water-tight covers, (like tubs light and of neat appearance), are common, low-priced and easily procured by the butter-maker. But whether they can be procured or not, there is no question as to the great need that a tub be brine-tight. It is the brine that surrounds the butter in the tub and excludes the air from direct contact—which does the most to protect and preserve the butter. Unless the cover is tight, it is a chance if the tub will stand shipment any distance without loss of brine. It is even a question if the tub can be packed so that the butter will be and remain completely covered by the brine Another reason that the cover should be air-tight, is the necessity for excluding unwholesome odors from the butter. Butter in stores, depots, cars, warehouses, vessels and retail shops, is liable to be subjected to unpleasant or foul odors, some of them being of a most penetrating character, say coal oil, stench of vessels, etc., etc. The simplest and most effectual provision against these is a perfectly air-tight cover on a proper and well prepared tub.

A water-tight cover is an essential that is lacking in most of the tubs in the market. If such a tub were obtainable it should be preferred. It would prevent loss of brine, and access to the butter of impurities. It would also allow of more effectual filling of the tub with brine, and easier inspection of the butter, without disturbing the contents.

Seventh. The tub should be **Cheap**. Since the tub cannot be used for the same purpose twice, and when the butter is used out it may be sold for a trifle, or thrown away if necessary, the purchaser cannot pay much for it. If the producer gets little or nothing for his tub, he cannot, of course, afford to pay much for it. If the future gives us a tub that may be used over and over again, or has an intrinsic value to the consumers for another purpose, so that the dealer can afford to give the producer something for it, it may be adopted to the profit and advantage of all. Such a package would doubtless be more used for local than foreign trade.

A tub with an air-tight cover might have a small hole bored in the bottom, to be stopped up by a plug. When the bottom is packed and the cloth put on, the cover is fastened down. The tub is now turned upside down and brine poured in at the bottom. Time is given to allow the brine to soak in and fill the tub perfectly full, the plug standing loosely in the hole, to exclude the light.

CLEANSING Dairy Utensils and the Material Used in Construction of same. Water and heat are the main agencies in keeping dairy utensils clean. Both of these are so cheap and abundantly available that there is little excuse for not using them freely, unless it be lack of knowledge.

The use of **Water**, as everyone knows, is that of a solvent, to soak up solid particles ; and that of a vehicle to hold and carry those particles.

Heat renders water more penetrating, and quickens its action ; it also kills the germs or ferments which induce decomposition.

The secret of cleaning vessels is to make the earliest and most liberal use possible of these two agencies, especially that of water.

The first rule in washing vessels is to keep the vessels *always wet when in use.* The nature of water being to cling to walls of vessels and fill the pores, we use it when possible as a *preparation* of the vessel—that it may stand guard, as it were, and drink up whatever comes along. This is a precaution, for by so doing we really *prevent access* to the pores of the vessels of the objectionable matter, and so render washing more easy as well as more effective.

It is for this reason that we see to it that dairy vessels are *thoroughly wetted before being used.*

To get the quickest and highest effect, we use water that is scalding hot, cooling the vessel afterward, when necessary, with a cold rinsing.

The more porous the material used, the more need, and the longer the time necessary to prepare the vessel. So it is that for tin a momentary scalding is enough, but for wood a more thorough soaking and scalding are necessary.

Having in mind these points, we need have little difficulty in the matter of always keeping dairy utensils clean. In the use of milking-vessels we find it impracticable always to prepare the vessels by soaking, so we use the least porous material we can find that is otherwise adapted. Wood is discarded as altogether unsuitable for this purpose, and tin is substituted.

Wood for milking-pails would not be objectionable, if this one fault were removed—if the pores could be filled and made hard and impervious like tin. Paint does not do, for it soon wears off.

For many articles in the dairy, however, wood is preferred, as its very porousness is made to serve a useful purpose. Water enters these pores so thoroughly, and, when the wood swells, becomes so fixed in its place (as if held in a vice), that it is difficult for anything to find lodgement at all. Hence wood thus prepared is not so "sticky" as the less porous tin!

Thus it is that most implements intended for working butter (where it is an object to overcome the sticking tendency of butter) are made mostly of wood. Such implements are churns, butter-presses, trays, ladles, packers, stamps, etc. For such instruments as ladles and presses, hard-wood is to be preferred. The pores are closer, and the butter has less chance of entrance. The pores are not too close to prevent filling them with the protecting element. With reasonable care they may be kept perfectly clean.

For churns, soft wood is for some reason preferable; on account of its lightness and because there is less trouble from shrinkage and swelling, and leakage. No difficulty need be experienced from the large pores of soft wood in churns, for the butter when it comes into contact with it is well protected by a liquid—cream, butter-milk, water, brine, &c.

Now in the fact that butter sticks to wood under certain conditions and does not do so under other conditions, is the suggestion of the secret of keeping wooden dairy utensils always clean, or, in other words, keeping the pores of wood always free from grease! When the butter sticks, it is because it *enters the pores*. When the butter does not stick it is because it *cannot find entrance* to the pores. The reason butter cannot stick is because the pores are already filled (with water or brine) and the butter cannot get foot-hold. To keep butter out, then, it is necessary to supply the very conditions under which butter is prevented from sticking, or in other words to thoroughly soak the wood and swell the pores before letting butter touch the wood.

Manifestly, if this condition is *always maintained*, the wood will *always be free from grease*, or, in so far as concerns this influence, *always as good as new*.

If this condition be not maintained, what is the result? We may find an answer in the trade of tanning leather. A very capable currier taught the writer how to oil boots in a way to fill the pores of the leather with the oil, and prevent the injury to the leather that results from ordinary "greasing." The directions were to thoroughly soak the boots in water, to cover them with a heavy plastering of thick oil, or grease, and then to leave the boots hanging for some days where they would dry very slowly. The result would be that the water in the boots would evaporate from the side of the leather *opposite that covered by the grease*; and as the water would make its way through the pores, the grease would *follow closely behind it!* In time all the water would be evaporated from the inside of the boots, and the thick coating of grease would have disappeared wholly from the surface, and the pores of the leather would be almost completely filled with oil.

Now, the object sought by the tanner is the very thing to be avoided by the dairyman. If a butter-press be left with butter standing in it long enough for the water to soak away into the wood, or evaporate, it will draw the butter after it as surely as nature abhors a vacuum.

When milk or butter gets into the pores of the wood, the water it contains will, in time, evaporate, but the grease or oil will stay in it, as long as the wood is wood. All after-washing swells the pores and shuts the grease in! Soaking and drying the wood simply draws the oil in deeper and deeper.

So it is that in time a piece of wood used as a churn or butter-worker becomes so filled with grease that it is absolutely unfit for butter-making.

All this is avoided by the simple precaution to thoroughly soak the wood before use, and by the quick removal of butter when it is no more needed in contact with the wood!

This explains how it is that the churning may be done year after year, and, by simple scalding, without use of soap or cloths, the churn be kept for years as free from grease as it ever was. It is due to the thorough soaking of the churn at the beginning, and the quick removal of the butter and rinsing of the churn, before the churn has had time to dry, or the butter to stick; the use of scalding water first and last, making the work all the more rapid and effective.

Since it is necessary to have the utensils very wet when in use, they need not be allowed to become absolutely dry between-whiles. To do so is to submit them to too much shrinkage and swelling. The wood will warp, the churn will leak, the cover will not fit, the butter-press will have open cracks, the butter stamps will crack and split. It will be well to set these wooden utensils where they will quickly dry, be thoroughly aired; but it is not necessary that they get so dry as to cause shrinkage.

The moulding of the implements, however, from dampness, must be guarded against:—

First, By way of precaution, in the construction. The *wood* to be used for dairy implements should be *selected*, free from sap, as clear from knots and free from other defect as possible.

Second, implements, before being used, should be prepared by a most thorough scalding and soaking in *brine*, and frequently the ordinary scalding should be with brine, so that the pores would become permeated with salt.

Third, a quick drying of the implement immediately after use. By using hot water to rinse the churn, the evaporation of the surface dampness is more rapid, and yet the implement may be set away without risk of getting too dry before it will be again wanted. After a good scalding and a quick evaporation, no use of cloths, or wiping, is called for.

Fourth, by storing the implements in a place that is not damp and mouldy, nor yet too dry, between churnings, there need be no risk of mould on the one hand, nor shrinkage on the other. The implements need not be set either in a damp cellar, nor long in the sun.

As to the influence of *heat* in washing dairy utensils, besides its use in rendering the action of water more effective it has the other effect, already referred to, of destroying fermentive life. This use of heat is especially required in washing milking-pails and milk-setting vessels.

It is sometimes necessary to give new vessels before using them a very thorough cleansing to remove a natural wood taste. If the best selection of material has been made, this is not difficult to do, for a good soaking with brine would be enough. Dr. Fleischman, however, recommends for some woods, such as fir and even oak, that they be washed with boiling lye, then rinsed with weak sulphuric acid, afterwards scalded and rinsed with hot and cold water alternately, several times. If any wood taste remains, he would wash with a decoction of (juniper) boughs. All this may be well enough, it ought not to be quite necessary in ordinary practice.

Filling a vessel with sweet hay, pouring in scalding water, covering up and steaming it, is a simple and sometimes effectual means of sweetening wood. This followed by the brining, which is always necessary, in order to fill the pores, ought to be enough. The scalding of such vessels frequently, if not daily, will prevent the too rapid souring of milk.

The use of soap is a matter of choice. The free and abundant use of water and heat will make the use of soap generally unnecessary. There is no objection, however to the use of soap, occasionally, for tin vessels, provided it be removed *completely* by thorough rinsing with pure water. Alkali, whether in soap or in water, as it is sometimes found, has no place in milk for butter-making, and its use should always be followed by liberal rinsing with pure water.

Among the methods suggested for washing milk vessels, are the following: The washing of tin vessels first with hot water, and with soap to remove the grease, then rinsing, and then scalding with boiling hot water, afterwards wiping with *clean, dry* towels and placing out of doors to air in the sunshine.

Dr. Lehman recommends first washing with warm water, then scalding with hot water, drying in the air, washing again with diluted caustic soda, and, lastly, a thorough rinsing with pure cold water.

If one can keep the vessels clean without so much labor, it is very well; but when the tricks of the cream suggest something wrong, it may be found good economy to take a little pains to see that the vessels are cleansed by some effective process of washing which the above may suggest.

The hard woods suitable for milk vessels are white wood, hard maple, birch, oak; and the soft woods, balsam, spruce, fir, pine.

For the use of milk vessels with which butter does not come into contact there seems to be nothing superior to tin. It is non-absorbent, easily cleaned, light, easily handled, durable, and cheap. Being a good conductor of heat, it is excellent material to use for rapid cooling of milk. Tin vessels for milk should be smooth as possible, that there be no corners for lodging dirt, &c. For this reason, *pressed* tin is sometimes preferable. The *purest* tin should be used for milk purposes.

In all this there may be little or nothing new, yet there is reason for devoting space to the subject. In one dairy one will find a churn that has been in use for years and is yet as sweet as ever; and in the next dairy a churn that in a few seasons' use has come to be so bad that to smell it is to turn one sick, to churn butter in it is to spoil the butter. So long as such a state of things exists, there is surely reason for pointing out the very simple and easy but effective means of avoiding the evil.

WATER has many uses in dairying. It is used in feeding stock, in washing vessels and utensils, in heating or cooling milk and cream, in washing and pressing butter, and in preparing tubs for packing. It may be used both for cooling and for purifying the dairy, and for ventilating and purifying milk when set for cream-rising.

Impure water has no place in dairying. Only pure water should be given to cattle; only pure water should be used for washing butter. All this is imperative. If the cow drink impure water, it goes into the milk more or less impure. Butter washed in impure water is affected in more than one way. Butter being extremely sensitive will suffer by the slightest contact with impurity; and, again, some of the water or its impurities will be left in the butter.

The use of water, as advocated in this MANUAL, and practiced by advanced butter-makers in France, England, and America, is condemned by the Danish system, which imperatively demands that *no water come into contact with the butter!* It is thought by the Danes that the less water, the better will the butter keep; and so it is preferred to dry-work the butter, or to wash it *in skim-milk*.

This position may be a right one; but there is reason to believe that the use of water is not *necessarily* so objectionable, as believed, and that, at least generally, such use may be preferred to the over-working of butter, and the larger presence of butter-milk, that characterizes the dry-working or milk-washing system.

It is stated that a sample of Danish butter exhibited at the Centennial Exhibition, which had shown extraordinary keeping quality, was *water-washed* butter! This is a noteworthy fact.

Another noteworthy fact is that the water used in washing this butter had been PURIFIED, *by boiling*.

The question naturally arises whether it is not the *impurity in water*, rather than water itself to which the most objection may be made. It is possible that Danish water is characterized by some defect that makes it unsuitable for butter. It is certain that in all countries there is more or less water so characterized. Doubtless, then, the important question is not whether it is safe to use water in washing butter, but whether or not the water to be used be PURE.

Butter that has been water-washed has shown good keeping quality, not only in the case of Danish butter referred to, but in the practice of thousands of dairies in different countries. This fact is enough to show that water-washing in itself is not to be condemned. The known fact that a great deal of water contains much impurity is enough to account for all the instances of failure that cannot be accounted for by such causes as defective methods.

In view of all this, it must be urged upon dairymen that the system of water-washing, or brine-washing, butter in granular form, imperatively demands the use of *pure water*.

When the water available is not pure, means should be taken to purify it; if that cannot be done, it may be well to adopt the Danish system either of dry working, or washing in sweet skim-milk. In the dry-working system, however, it will be even more necessary than in the water-washing system, to churn the cream before it has far advanced in souring.

Whatever may be the comparative merits of the two systems of butter-making, there is no doubt at all that the success of the water-washing process hinges upon the *character of the water*—whether or not it be pure.

Sources of Supply of Water. There are two main conditions which influence the purity of different waters.

First. The extent which the water is *loaded with foreign matter.* Water itself is not impure, it is merely a holder of impurities.

Second. The *character* of that foreign matter. The *kind* of impurity has more than the *quantity* to do with the character of water. For instance, of all impure water, that defiled with sewerage seems to be the worst. The addition of only one grain to the gallon of sewerage defilement was found, in the cholera epidemic of 1866, in London, to be directly connected with seventy-one per cent of the whole mortality. One grain to a gallon is a small proportion of the general impurities in almost any city water; for at one time the water used in New York city, on Chambers and Read streets, had not less than 125 grains!—so says Dr. Trall.

The extent to which water will be loaded with impurities will depend upon *first*, that with which it *comes into contact.* Water coming from the clouds pure will absorb the impurities of the atmosphere. Water percolating through the earth may sometimes be filtered and purified by the earth, and it may sometimes become adulterated by absorption of minerals, gases, &c., found in its course.

Second, upon the *swiftness of its motion* will water depend, for its purity.

Other things being equal, running water is the purest; and the swifter the current the purer the water. Standing water soon becomes stagnant water, always to be avoided. Ever give the preference to water that is quickest renewed, or in other words, the *freshest.*

Spring Water is perhaps the most common source of supply to the dairyman. The properties of spring water depend upon the nature of the soil. The water of many springs is hard, owing to earthy and saline matters, the most common of which are sulphate and carbonate of lime. Water intended for washing butter should not be hard from the presence of lime or anything that could injure the butter by contact with it. Indeed, hard water is always more or less objectionable, whether it be for butter; or for drinking purposes for man or beast. Soft water is not always pure, but pure water is always soft.

Well Water is much depended on for household and dairy purposes and wells are very useful, but they are open to grave **Objections.**

First. Every well is necessarily a "**Draining Pit,**" and drains a certain area of ground, even as a river drains the land along its course. The extent of that drainage depends upon various conditions, such as the *depth of the well*, the *lay of the ground* and the *nature of the soil.* Care must be taken to locate the well at a safe distance from privy-pits, barnyards, and general slop-waste. The health of the family, as well as the needs of the dairy, demand this precaution.

To Correct the Fault. If dependent upon a deep well, and one too close to the house something may be done, perhaps to remedy the evil. The following plan, described in *Scribner's Monthly*, seems to have merit:—

Construction of a Well. "The well must be so constructed that it cannot act as a drain for the neighbouring soil. This can be done either by making the wall above low-water mark of some material impervious to water; or by omitting this part of the wall altogether. The first can be accomplished by having the wall from a point two or three feet from the bottom made of brick, with a coating of hydraulic cement on its exterior, or of hydraulic well-tubing, with the joinings well protected with cement; in either case, the earth should be thoroughly packed around the wall, and a slight embankment should be made around the orifice to prevent the inflow of surface or storm water.

"In such a well the draining surface is so reduced, and placed at such a distance below the ground, that, in the great majority of instances, the introduction of foreign matter becomes almost impossible, except in so far as there is a chance that substances will fall into the well from above. To prevent this the well should be covered when not in use.

"In most cases, however, it is better to omit the upper part of the wall altogether. After the excavation is completed, the wall can be built in the usual manner for a distance of two or three feet, more or less, as circumstances may demand; service pipe can then be placed in position, and the well arched over. The remainder of the excavation can then be filled with earth, well packed as it is thrown in, and the pipe carried to any convenient point. It will be necessary to place above the arch several layers of stone successively smaller, to prevent the falling of earth into the space below.

"The workmen will probably suggest a layer of turf or straw to accomplish this object, but the presence of either of these substances will cause the water to be unpleasant for a considerable time, and will prove the cause of much annoyance.

"There is a prevalent notion that the well should be ventilated for the purpose of allowing noxious gases to escape; and that water should be exposed to the air. I hardly need state that the only noxious gases in a well (*i.e.*, gases which render the water unwholesome) are the products of the decomposition of organic matter which has found its way into the well, in ways which have been described above, and that water as it flows in its subterranean passage is more perfectly aerated than it can be in any other way."

The *second* objection to which wells are open is this, that they become **Reservoirs of Sediment.** In many wells there is an accumulation of muddy sediment full of organic matter. It may have no other fault, but this will be enough to spoil the butter.

The writer has in mind a gentleman who, in using water from his well for washing butter, allowed the pails to stand a moment for the sediment to settle. No other precaution was taken, not even that of straining the water. Yet this was an unusually intelligent and accomplished gentleman, a prominent public man, a progressive agriculturist and an educator. The well at the time referred to was very low.

Prof. Arnold says he once saw a lot of butter spoiled for use, in twenty-four hours, by being washed with water from a well which was low, and in the water of which was more or less sediment.

The dryer the time, and the lower the water, the less frequently the water changes and the more it is tainted.

Where one is dependent upon water under such conditions, either the water should be purified, or it should not be used for washing butter. Straining and boiling the water, allowing it to settle and straining it again, will do much towards purifying it. To filter the water afterwards will be still better.

The *third* objection to well water is that it is sometimes **Impregnated with Earthy Salts.** This fault is believed to be more common with well water than with spring water. Such hard water is not suitable for use in washing butter, but it is not so bad as water contaminated with putrifying animal and vegetable matters.

Rain Water is considered to be the purest of all waters. The first rain which falls, after a season of dry weather, is more or less impure; it is loaded with the impurities of the air, and with dirt washed from the roofs of houses from which it is collected. After a time of continuous rain it falls almost perfectly pure.

In collecting rain water in cisterns, it is necessary to provide against the first rain which falls entering the cistern.

"**River Water,**" says a high American authority, "is an admixture of rain and spring water; it always holds in suspension a greater or less amount of extraneous matter, and in and around cities is strongly contaminated with decomposing animal and vegetable matters. Much of the rain water of this country (America), as it runs through the sparsely-populated districts, is comparatively quite pure and healthful."

Most of the river water, when it is defective, could be utilized for butter-making purposes, by boiling, straining, and allowing it to settle.

Quoting from the same authority: **Lake Water** is "generally very impure, being a collection of rain, river and spring water, contaminated with putrifying animal and vegetable matters.

Marsh Water is similar to lake water, but still more loaded with offensive and putrescent organic matters."

Leaden Pipes. "The purest water will become impregnated with poisonous properties when conveyed through some kinds of metallic pipes, particularly lead ones. The air contained in very pure water rapidly corrodes lead. Rain water is often impregnated from the lead of roofs, gutters, cisterns and pipes. Combinations of lead, iron, and zinc, and other mixed metals, as in cases where iron bars are used to support leaden cisterns, etc., often produce a galvanic action which dissolves a portion of the lead,

As a precaution, it is well to let run to waste as much water as the leaden pipes contain to their junction with the larger iron pipes. With this precaution, and the frequent emptying of the leaden pipe through the day, it is not probable that any appreciable injury will be experienced from the lead in pipes. A substitute for leaden pipes should be provided, if possible.

What has been said will emphasize the importance of every dairyman at once making sure that he is provided with water as pure as is available in his circumstances.

How to Determine when water is impure. The appearance of water is no indication of purity. "Sewage water that has had the crude portion of its impurities removed by imperfect filtration, is not only clear and sparkling, but peculiarly pleasant to the taste, from the gases and salts which it contains, but it is nevertheless the source of some of our most fatal diseases."

Prof. Orton, of Ohio, says of the limestone wells, in thickly-settled areas, as towns and villages, that the water which they furnish is very grateful to those who use it, for it is cool because of the depth from which it comes, and clear because it has been filtered of all grosser impurities: but despite its clearness and coolness, it may be laden with the germs of the deadliest pestilence.

The first thing to be done is to *make an examination* of the sources of the water in use.

An examination will not prove that the water is pure, but it may prove that the water is impure. For instance, the water may be stagnant, or the well may be so close to the barn and other out-buildings that it cannot escape defilement from drainage; or the water may be swamp water; or the well may be low, and in scant supply and full of sediment; or the stones of the well may be covered with a gelatinous matter; or the spring may be filled with decaying organic matter—wood, leaves, &c. In all such cases, one may know that the water is not pure for the all-sufficient reason that it cannot be otherwise than impure.

Look first to the *surrounding soil.* If the soil be porous and absorbent, it will drain the impurities as it cannot do if it be hard and impervious to water. Look, also, to *depth* and to distance from source of impurity. It is said that a well will drain the surface soil from all points for a distance *four times its depth.* Having this in view one should locate wells far enough distant from the water-closets and barn-yards to be on the safe side. In barn-yards there are constant accumulations which drain directly into the soil and are sometimes carried by streams to a distance, which bear germs of disease for man and beast. Have a care to avoid all risk and chance of such evil.

Where there is no well-grounded proof of impurity, but some doubt as to purity, one may avail oneself of some of the possible **Simple Tests.** There are many tests known to science, but there are only a few that are practically available.

Boiling is a good test to know if the water is impregnated with carbonate of lime. When water is boiled, the *carbonate of lime* (that was previously held in solution by the carbonic acid) is *deposited* at the bottom; this is the deposit which lines tea-kettles and boilers when hard-water is used.

Another test of hardness of water is the **Action of Soap.** In hard water, soap is curdled and decomposed; in soft water it mixes readily and forms a *suds.*

The **Glass-Vessel Test** has been recommended, but has never been used by the writer. Fill a clear white glass bottle and place in it a few grains of lump sugar. Cork it well and place in the sunlight. After eight or ten days, should the water become turbid, or an odor be perceptible, it is proof of contamination. If not so contaminated the water will remain clear.

How to Purify Water. Chemical agents are sometimes made use of to free water from particular ingredients. Generally, however, they do not render the water purer for use. For instance, *alum* will cleanse muddy water, but that is all it will do; it does nothing to add to the wholesomeness of the water, and it renders it even harder than before. *Alkaline carbonates* will soften water, as soda and potash do when used for washing purposes; but the water is no purer for drinking.

Boiling is one or the best means of purifying water. The heat "destroys the vitality of any animal or vegetable life it may contain, expels air or carbonic acid, and causes the precipitation of carbonate of lime." Boiling is so simple and effective a process that it ought to be more generally practiced by the many dairymen who are using water that needs to be purified.

Filtration comes next to boiling, and would be advantageous sometimes as an additional precaution. To filter water well is to "remove all insects, living things and impurities, but not to deprive water of the substances it holds in solution."

It is claimed, however, for one filter, that it *will* purify foul water from organic impurities held in *solution*, as well as from suspended solids. Whether or not it will do this, it is a good filter, and deserving a trial by any who needs one. Here is a description of it:

Filter: "Take any suitable vessel with a perforated false bottom, and cover it with a layer of animal charcoal; on the top of that spread a layer of iron filings, borings or turnings, the finer the better, mixed with charcoal dust; on the top of the filings place a layer of fine clean siliceous sand, and you will have a perfect filter. Before placing the iron filings in the filter they must be well washed in a hot solution of soda or potash, to remove oil and other impurities, and then be rinsed with clean water; the filings should be mixed with an equal measure of fine charcoal. The deeper the bed of iron filings, the quicker they will act.

"Allow the foul water to filter slowly through the above filter, and you will produce a remarkably pure drinking water. The more foul the water, the more slowly it should be allowed to filter."

THE ICE-HOUSE. Ice in any dairy is a great convenience. Whether or not it will pay to provide it will depend upon the cost and labor involved, and the advantage found in its use. In most ice countries, the cost of storing ice is only a little expenditure of labor, and so light that it is an exceedingly profitable investment.

Ice is of great advantage in *milk-setting.* Where one has an abundance of very cold water, the advantages of ice, for creaming milk, possibly may not always compensate for the labor; but in an ordinary case there is gain in its use, if only during the hot season.

But it is in the *granular process of churning* that the use of ice is generally of greatest advantage. Here ice is invaluable, and the dairyman should have the few pounds necessary for churning-day—even if he were obliged to purchase it of a dealer or of a neighbor.

There are, mainly, two **Conditions of Ice Preservation:** *First,* a **Low Temperature:**

For protection against heat, dependence must be placed, mainly, upon the construction of walls and roof. The best material of isolation is wood, saw-dust, cut-straw, anything that is porous, and a slow conductor of heat. The more porous the wood the better—such as hemlock, spruce, pine, &c. Dead-air spaces serve a like purpose. Suggestions of possible means of accomplishing this will be found in descriptions of dairy buildings, on previous pages, and of ice-houses farther on.

The *Second* condition is **Dryness.** It may seem a strange fact, but it is true that this condition is even more important than the first-mentioned. Air is not nearly so good a conductor of heat as is water. Even a child knows how quickly the hands will get cold when they are wet or even damp. The difference there may be in the amount of moisture in different atmospheres is comparatively slight, but one atmosphere may be so much dryer than another that several degrees more of actual cold will not be felt. If a melting cake of ice be allowed to stand in the water which drips from it, it will melt much faster than if it be surrounded by the air.

To secure against loss from this influence of dampness, the ice should be so placed that the drippings be carried off and away, so that the material standing between it and the surrounding atmosphere, be as *dry as possible.*

The **Bottom of Ice-House** is important. The floor of ice-pile should slope to the centre, for the double need of carrying off the water, and throwing the weight of the ice towards the middle—that it may not press hard against the walls of ice-house. Let no less care be taken to afford quick and thorough drainage of the water that melts from the ice, than in protecting the upper walls against heat. A tight and sloping floor is essential, with a channel for carrying off the water, and such may be built in various ways.

Ventilation. It is usual to ventilate the ice-house near the roof, for the purpose of carrying off moisture. The writer has met with one ice-house, however, that was purposely left without ventilation, upon the claim that, with good drainage, there was more loss than gain by ventilation. The ice-house referred to was one designed for himself by an architect—a very intelligent gentleman of an inventive mind, residing in Prince Edward Island.

Size. An allowance must be made for waste. The smaller the quantity, the more allowance in proportion to the whole quantity. For instance, a four-feet cube of ice would be likely to melt before any or much of it would be needed. A ten-feet cube would be only partly lost. It would not be economy to build an ice-hoouse less than 10 to 15 feet ground surface, and 8 to 10 feet high, and as much larger as thought desirable. Build too large rather than too small. A building 12 feet square and 8 to 10 feet high will give a supply of ice for churning and household purposes, for small dairy farms.

A cubic foot of ice, well packed, with the interstices filled with broken ice, weighs about 45 pounds. The number of tons of ice contained in an ice-house may be determined approximately by the following **Rule**: Multiply length, width and height of *ice-pile* to obtain cubic feet, and divide the number of cubic feet by 45. For instance, an ice-pile 10 feet square and high would contain (10 × 10 × 10) 1,000 cubic feet, which would contain about (1,000 ÷ 45) 22 tons.

Division into compartments. There is a manifest advantage in dividing large-sized ice-houses into sections. The ice may be removed from one section at a time, and thus prevent waste of ice. The building may be somewhat long and narrow, and divided across. Make the division wall double, and fill it with the material used in outer walls.

Cheap Ice-Houses. An ice-house made of *poles* is thus described: "The poles are built up into a pen of the desired size, being notched where they rest upon one another, to prevent their rolling and to lessen the cracks. The gables are left open and the roof projects three feet at each end. The roof is of clapboards, nailed to pole rafters and to cross-pieces."

A layer one foot thick of old rails, closely laid, was put on the bottom for a floor, and also to provide drainage." Saw-dust was used to fill in and cover the ice.

Another: Set posts in the ground about four feet apart, and board up on outside, and put on a cheap board roof. Excavate the earth about six inches deep; and fill in one foot deep of sawdust, to rise about six inches higher than the surface earth. Pack the ice in solidly, leaving a space of not less than eighteen inches all around, which space fill in with saw-dust. Cover the ice with about two feet of saw-dust. One plan is to leave the space above the saw-dust open for circulation of air. A better plan is to put in a roof floor and fill with some dry non-heat-conductor, such as saw-dust, tan-bark, straw, &c.

An Ice-pile in Shed. The writer has seen a summer's supply of ice stored in a shed at a cost of barely more than the hauling and packing. A foundation is laid for drainage. This may be of rails, stones or saw-dust. Set posts about one foot from the ice and board up. The walls of the shed may serve for two and sometimes three sides of the pile. Fill the space with saw-dust; or with straw, cut fine and packed hard. Cover the top of ice nearly or quite two feet deep. See that not only the ice is covered in on all sides, but that the foundation—rails or stones—are also protected from air by a hard packing of saw-dust or straw.

An Ice Stack. "Those whose ice-houses are so limited that they fear the supply stored in them may not last through the hot season, may readily supplement them by means of an ice-stack. To make this, first set a stout pole in the ground, and then lay down poles, timbers or rails, for a foundation, upon which place an abundance of straw. Stack the ice closely around the central pole as compactly as possible, and as high and as broad as may seem desirable. Cover the ice-stack with straw to a sufficient thickness to prevent melting, finishing off with long straw, or it may be with corn-stalks. The early demands for ice may be met by drawing upon the stack, by taking what may be required from the top, and closing it carefully after each opening. If the ice-stack be built within the shade of a tree or building, and well cared for, the main ice-house need not be opened until the season is well advanced."

An Ice-Pen. On a well-drained convenient spot, make a fence of rails, or poles, and pack the ice within it. Raise fence about one foot, and then make a bottom for the ice by a layer of rails, or a bed of saw-dust or straw.

Lay up the blocks of ice in the usual manner, and build up the fence as fast as the ice-pile rises. Leave a space of at least one foot between ice and fence, which space fill with the material at hand for the purpose. Cover the pile with about two feet of straw well trodden, or nearly that depth of saw-dust. Make a cheap roof with slabs or old boards.

Ice may be stored, also, in the barn. After the hay or grain has been removed from one of the bays, it may be used without hindrance.

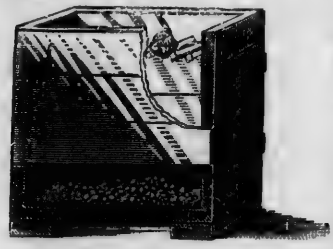
Tools for Ice-Harvesting. For cutting ice, one may use a common cross-cut saw, with a handle on one end and the other end clear.

For taking the ice-blocks out of the water, a ladder is convenient. It should be about 12 feet long, and be provided, near one end, with an iron prong, about 6 inches long, on each side-rail, inclined slightly inwards.

The prong end of the ladder, prongs upward, is pushed under the blocks and they are then drawn out of the water on the ice-field.

Manufacturing Ice Blocks. Where pure ice cannot be had within a reasonable distance, one may make ice by freezing the well water into blocks. Make *snow-boxes*, hard-packed, of any convenient size. Put in a little water at first, and when it freezes a solid bottom, add more water till full. The snow may be removed and the ice-block drawn to ice-house. Take advantage of the coldest weather, and for convenience use open spouts to carry water from pump to snow-boxes. Or a large snow-basin may be made, say 15 to 18 inches deep, the bottom and sides made tight by water when freezing. Pump the basin full of water, and when hard frozen, saw into blocks the ice-bed thus formed.

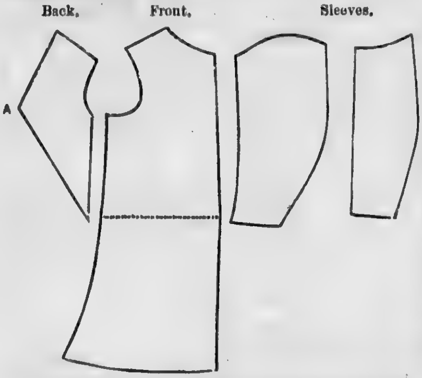
The Coöperative Plan is to be recommended to any group of farmers, who, having good cellars or cold water for milk-setting, require ice only for churning day, and for general household purposes. The cost to each dairy would be so little that it would hardly be felt at all.



Breaking Ice. Where ice is used, and in small pieces, it will be convenient to have something with which to break it up. The engraving illustrates a box with an iron grating, and a door in the end for removing the broken ice. In the engraving a board is removed at the bottom to show the broken ice inside. The ice is broken with a large iron hammer.

Ice-Savers. It is sometimes necessary to keep ice over a day or two, after removal from ice-house. A cheap ice-box may be made with double sides and packed with saw-dust between. One two feet long and deep, and twenty inches wide will hold a block of ice, and leave space on top for cold storage. Two or more slats should be laid on bottom, to raise the ice above the meltings.

Smaller pieces may be kept from quick melting by hanging them in a cool place in a flannel cloth or bag.



PATTERN FOR DAIRY AND MILKING APRONS.

A Convenient Apron. An illustration on a previous page, under the head of "Packing," (p. 37), shows a Dairy-Apron that will be convenient for general dairy work. The pattern of that apron is here given. The same pattern will serve also for a milking apron. The pattern shows one-half the apron. For a *Milking-Apron* (or stable apron), the front is divided across the middle, say near the dotted lines. For the lower part a wider piece of cloth may be used, which may be gathered into folds. This will give it a larger skirt, so that it will cover the knees while the milking-pail is held between them. For a *Dairy-Apron* the *front* is made in a single piece. Two buttons are sewed on the front of the apron, to which a clean towel may be fastened, for use in wiping the hands—a frequent necessity in doing dairy work (See Illustration, p. 37). The strings for tying the apron are atttached, one at each point at the back (A). In tying, *cross the strings at the back*, bring them to the front and there tie them. If preferred, they may be made of sufficient length to reach again around the person, and be *tied behind.*

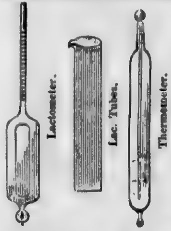
The peculiar merit of this style of apron is the complete manner in which it protects the body and arms of the person, and the ease with which it is put on and off. There are no buttons to be buttoned. It can be made in an hour or two by almost anybody that can use a needle; and will cost for material from only 30 to 60 cents, for cheap calico or heavy cotton.

If the dairyman will go to the trouble of having one of these aprons made for him, it will soon become a favorite article of use. He may wear it when milking, or when carding the cows, or at other stable work. On special days when the farmer has on his holiday clothes, such an apron would be especially useful for it would prevent spoiling his clothes, should he happen not to make a complete change of dress. In any case, by its use, the ordinary clothes of stable workers will be saved, and be kept cleaner for wear throughout the day, at general work, and especially for carrying milk into the dairy. It is one of those simple expedients which may be adopted by the farmer, as a practical and easy means of securing, in a measure, a like result to that attained, at the expense of greater pains, by the makers of fancy brands of butter.

The aprons here described have already found much favor with the few to whose notice they have been brought. A neighboring wood-turner found it especially adapted to his shop-work, and requested the pattern. They were devised for the special need of the farmer-dairyman, by the writer, whose only wish regarding them is that others will find as much satisfaction in their use as has he himself.

Foot-Wear for stables. Another convenience is an old pair of rubbers, of large size, easily put on and off, to put on when milking in the stable, and to pull off when entering the dairy or the house. If it were only for the sake of cleanliness of one's person and the saving of one's clothes, it would be quite enough to warrant the little cost, and the almost as little trouble in the wearing, of a milking suit which needs to include only an apron, a pair of rubbers, and a suitable hat. This light precaution would be an easy way of helping—so far as it goes—to transform a common cow-keeper into a gilt-edge butter-maker. By some such easy means we may attain to the same results that have been attained in some cases at a much greater cost in painstaking. It is said that the mistresses of dairies in Normandy often turn away their maids for not having changed their shoes before entering the dairy. This has the look of over-scrupulousness; but it seems to pay. After the fastidious Paris market has absorbed the choicest portion, the balance, or second quality, according to Long, is placed on the English market to sell at a high price as superior butter, because it is labelled "Normandy."

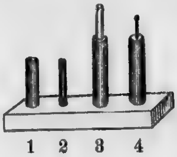
The description of a **Lactometer** will be found on page 13 of this MANUAL. A suggestion is there made of a use of this instrument in experimental work that is possible by any intelligent dairyman, with little practice.

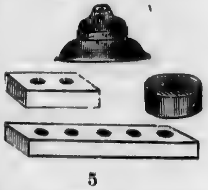


Along with a **Lactometer** is required one or more Lactometer Tubes. It will be convenient to have these as small as they can be and yet serve the intended purpose. Such tubes, of glass, may be purchased with the lactometer, or they may be made with tin at any tinshop, at a cost of a few cents each. A convenient size is ten inches high by one inch in diameter. These tubes should be provided with a small lip for pouring out the milk without spilling it. To bring samples of milk to proper temperature, the lactometer dishes may be set in a vessel of water, cold or warm, as may be required.

In connection with the lactometer and thermometer a convenience will be found in sundry **Small Dishes** of wood, for holding the instruments when one is done using them; and of tin, for holding the instruments in water when they are in use. The wooden dishes are perforated in the bottom, for draining off the water. Preference is given to wood in this case only because it is softer than metal, and not so liable to break the delicate glass instruments by the shock of placing them therein.

For holding these various dishes, and others of similar character, like cream tubes, wooden stands will be found very convenient. These are simply small blocks of wood, in which are bored holes of the right size to hold the different vessels.

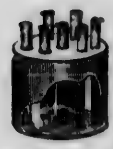




1. Wooden dish, for holding lactometer when done using it.
2. Wooden dish, for holding thermometer when done using it.
3. Tin dish, for holding lactometer (filled with water and containing the lactometer).
4. Tin dish, for holding thermometer (filled with water and containing thermometer).
5. Wooden stands, for holding tubes, &c.

The object of such conveniences will be manifest upon their use. It is necessary that these much-used instruments be kept always clean. They are easily broken, either in washing or wiping them, or in setting them down. The easiest way to care for them is to have *water-dishes* in which to set them while using them. When lifted out of these water-dishes, they are already rinsed; and they may be used again, or set in the wooden dishes to drain and there remain.

The cost of these tin dishes ought to be not more than five cents each. For wooden dishes the cheap cylindrical turned boxes in which lactometers are usually packed, will serve for two such dishes. They may be easily made, too, by boring a hole in a piece of block, turned the right size and round. Anyone has skill enough to make the stands, by boring a few holes in small blocks of wood.



A Creamometer is one or more small glass tubes graduated to show the the percentage of cream. The graduation is from the top of the milk downwards, beginning conveniently at least half an inch from the top. The tube is filled with milk to the top line of graduated scale—marked by a cipher (0). The milk is allowed to stand a sufficient length of time for cream to rise—say 24 hours, and at a temperature of 60°, or lower. The percentage of cream may now be read; it being indicated by the figure at the line of separation between the cream and milk. The graduation is not continued from top to bottom, twenty to twenty-five per cent. being amply sufficient for general purposes.

The creamometer, for some purposes, is a useful instrument, but its use is extremely limited. The instrument is very defective, from the fact that the appearance, or showing, of cream is no true indication of the richness of the milk. The relation between the bulk of cream and richness is affected by many causes: such as the character of the milk—variations due to different cows, or herds, or feeding; the conditions under which the milk is set; the length of time setting; and so forth. From the reading of the creamometer, only an approximation of the actual value of the cream can be made.

Keeping in mind its defective character, the instrument may be used in various ways. Where absolute values are not sought, it may be used for purposes of comparison. In such case, some of the causes of variation may be avoided, as when setting the milk under exactly like conditions. It is useful in factories where the milk is received on the basis of bulk and not actual value. It gives an approximate showing of value, and its frequent use will provide a *cream standard* for each herd; variations from which may lead to suspicion of fraud on the part of the patron. It could not prove such fraud, but would corroborate other proof to which suspicion might lead. The creamometer would be useful to the farmer, too, in testing his cows, where he could not employ more exact methods.

The **Delaiteuse** is a new invention for *draining butter* of any excess of liquid—butter-milk, water or brine. Like the machine cream-separator, already described, it is worked on the centrifugal principle, and generally, if not always, by power. It has not, like the centrifugal cream-separator, been largely introduced in this country; and it is likely that there will be a comparatively limited demand for it.

The mode of **Operation** is as follows: Granular butter is placed in a canvas bag, which bag is fitted into its place in a metal cylinder, perforated with holes, like an ordinary colander, or seive. This cylinder is now made to revolve rapidly, by which means the contents are subjected to centrifugal force. The result is that any liquid or excess moisture in the butter (being heavier than the butter itself) is drawn off to the circumference. It is then forced through he mesh of the canvas bag and the holes of the cylinder, and falls into the drum or case in which the cylinder revolves, and is carried off through a pipe below.

This operation leaves the butter in a dry condition, that is, freed from excess of liquid, or liquid that is not combined with the solid fat of the butter—and ready to be salted, and packed. Doubtless the butter may be freed of buttermilk, or water, more perfectly by the delaiteuse than by any other known method.

The **Conditions** involved in the operation are: *First*, that the butter be in a *granular form*, and *second*, that the *temperature be low*, or not higher than 55°. These conditions are equally essential in the system of churning (and washing) advocated in this MANUAL. The temperature in the latter case, at least, does not absolutely require to be so low as 55°, for draining or washing granular butter, but the work will be better done at that temperature than at a higher one. It is likely that the centrifugal process will be the most effective of the two, under like conditions; but it is certain that the ordinary process, carried out under favorable conditions, leaves little to be desired. It is not absolutely required that the butter be churned at the low temperature necessary to *delait* it. As in the granular process of draining, the butter may be chilled during and after the churning process; by adding either very cold skim-milk or water.

The delaiteuse doubtless would be an advantage in factories, and possibly in very large private dairies. Its use would make possible the carrying out effectively of the Danish process of *dry-working* of butter. This process has much in its favor, and would be recommended where the delaiteuse is used, with less hesitation than it could be recommended for the average farm dairy.

It is said that the butter comes from this machine "compact and dry, and free from cavities." If this means that it is in a solid lump, it is an objection on the score of salting; which objection could be removed only by *delaiting* with brine and thus leaving the butter salted. If it means, as it probably does, that the *granules* are compact and dry, the butter being still in the granular form, nothing better could be desired. The writer has had the opportunity of examining this instrument, but not of seeing it in operation.

The speed of the "Delaiteuse," or, as it may be called, the *Butter-Drainer*, is only about twelve hundred, while that of the "Centrifuge," or Cream-Separator, is from two to seven thousand revolutions per minute! The time required to drain each lot of butter, say 20 pounds, is about four minutes. The machine, therefore, will drain about 250 pounds per hour. The cost of the delateuse is probably about one hundred and fifty dollars.

Steam-Power for small dairy. At Cornell University is used a small upright boiler and engine of one-third horse-power, requiring 15 pounds of coal daily. It does the churning, and it furnishes steam for heating water and scalding utensils; it also keeps the room at the required temperature, day or night, although the outside temperature continues several days below zero. Such an engine would be useful in winter dairying. What is wanted for private dairy purposes is a light, simple and cheap motor that requires little fuel; and one that can be run by unskilled labor, without risk of explosion or like disaster. Steam-power, while a convenience in a large-sized dairy, is not an essential to the ordinary dairy of the farm.

A **Cream-Temperer**, or a tin vessel which may be filled with warm or cold water, and stirred around in the cream to warm or cool the cream. When warm water is used it may be of a temperature from about 105° to 120°.

Note.—Should one require any article outside of what is common property, application may be made to some reliable dealer in dairy goods for descriptive circulars. First-class dealers will usually be glad to forward, on application, illustrated Catalogues of Supplies, from which one may select what is required.

The exclusion by the writer of all proprietary goods is an action that, doubtless, will meet with the warm approval of every reader who desires to consult these pages with confidence.

Experiments: It will be well, sometimes, for every dairyman to determine for himself, by experiments made in his ordinary course of work, which of different processes gives the best returns. There has been so much theorizing in dairy science, and it is so difficult, at the present stage of the question, to know all the influences to which milk is subject, that the writer has in some cases, thought it better to *lay down principles* to guide the operator, and help him to follow out plans of his own, rather than give him absolute rules to be closely followed.

Experimental work will be more satisfactory if done in *duplicate;* especially when dealing with small quantities. Always label the different vessels, and make an immediate record; for in such work it will not do to trust to memory. It is a great convenience to have each vessel *numbered;* and then the facts may be set in a Record Book, against the number of the vessel rather than noted on a label upon the vessel itself.

Devonshire or Clotted Cream. Everybody has heard of clotted cream, and nearly everybody has had the good fortune to taste it. It is made by merely scalding the milk.

Says Mr. Long, "In clotting cream we have adopted two systems, setting the milk to scald, as it comes from the cow, and setting at the end of 24 hours, and we cannot say that we found much difference. In some cases the pans stood in hot water: in others, directly over the hot plate."

The experience of the writer goes to show that the largest *quantity* of cream will follow the practice of scalding the milk not when fresh, but after 24 hours. It will not do, however, to heat the milk after it has become far advanced towards sourness, for the heating will hasten acidity, and perhaps cause curds and whey.

Says Mr. Long again, "If the milk should happen to boil, a little cold water should be immediately poured in to check it, and the pan lifted off the fire. In this case the butter will not be so good; it will be without flavor and rough to the tongue, and it need scarcely be added that it should not be mixed with perfect butter." This difficulty would doubtless be avoided, in some measure, if the milk were surrounded by water instead of heated on a plate directly over the fire.

The principal advantage in scalding milk, according to Mr. Long, is that "when, from any unknown cause, the cream has made a practice of taking a long time to change into butter, the annoyance may in future be prevented by this plan."

Mr. Long says the cream will be clotted when the milk has been heated up to 160° or 170°. Where sufficient advantages from heating can be obtained by a temperature of only 140° to 145°, the writer would strongly urge not heating any higher, having in view *quality* of butter.

This Devonshire system, as practiced, however, hardly comes within the range of every-day scientific practice. On this point the following quotation from Mark Lane *Express* will suffice:—

"We find the Devonshire system of scalding the milk strongly advocated by the lecturer (Prof. Tanner), but whatever other merits that system may possess, it has not the important one of producing butter pure and free from any admixture of caseine. We do not find the finest butters, either English, French or Danish, made on such a system, and we do not consider it worthy of general imitation."

Churning Whole Milk. Where the practice is followed of churning the milk instead of the cream, a larger churn will be required. This is not a practice, however, likely to be much in favor hereafter.

The defects of the practice are: Labor in churning; sour butter-milk as a substitute for the more valuable sweet skim-milk; and, perhaps, an inferior quality of butter. The advantage claimed is an increased quantity of butter; but where there is greater weight of butter in churning whole milk, it is doubtless due to the fact that the butter is more loaded with caseine. In such case, quantity is secured at the expense of quality.

The claims of this process upon the consideration of the advanced dairyman were never very strong; and in these days of improved means of obtaining and handling cream, and better appreciation of value of skim milk, such claims are growing weaker than ever. In some special cases, where butter-milk in quantity is an object, the churning of whole milk may be an advantage; in ordinary dairy practice the question has ceased to have practical importance.

COÖPERATIVE DAIRYING. Primitive dairying was in the nature of things confined to individuals, or families. The factory system is the combination of individual interests, in some form, having in view the advantages of manufacturing on a larger scale than that carried on in a single family.

The **Factory System** is a natural outgrowth. It had its beginning in certain advantages which it possessed over the old system. It has grown to large proportions by virtue of a general merit in meeting at least some of the demands of progress. That this growth has been limited is owing to the fact that notwithstanding its merits it has still some imperfections.

The first attempt in the factory system as it exists in America was the building of a factory for the manufacture of *curd* into cheese; the milk being coagulated at the farms. This factory was built in 1844, in Connecticut, by Lewis M. Norton. This form of the factory system had not the elements of permanency and growth.

The second progressive step was the establishment of a cheese factory, where the milk itself, as received from different farms, was manufactured into cheese This may be considered the beginning of the present cheese-factory system. Jesse Williams was the originator, in Rome, N.Y., and so recent as 1851.

While this might have been a natural development of the system, it appears actually to have been an independent progression, and in a measure accidental. We are told by Prof. Arnold that the products of Mr. Williams' dairy would sell for a higher price than those of his son, living near by him. To secure for his son the same price he received for his own, he took his son's milk in with his own, the cost of manufacture being divided, and the product being shared, according to the quantity of milk furnished. The advantage in this was mutual and to one of the parties double. It reduced the cost to both parties of manufacturing and brought to one party—the son—a higher price for his cheese. This result led other neighbors to join the combination, and thus the system was successfully established.

The advantages of the coöperative system in cheese-making naturally led to its application to butter-making. It was naturally supposed that the factory system would do for butter what it had done for cheese, and many dairy economists looked forward to the time when the butter dairy would give way to the new order of things, even as the cheese dairy had done.

This expectation was founded upon a somewhat superficial analysis of the conditions. Two points are enough to give to show a fallacy in the reasoning: *First*. The factory system was not equally well adapted to both branches. Though butter and cheese were both made from milk, the processes are entirely different. As a matter of fact, the factory was better adapted for cheese-making than for butter-making, and the private dairy the reverse. Thus it was that when one was one taken and the other left, it was butter which was left. *Second*. When one branch was removed from the private dairy, there still remained another branch. Remove the second branch and there would be nothing left. To show that butter would follow cheese involved proof that the private dairy would cease practically to exist. No attempt has been made to offer such proof. In giving evidence before a Committee of the Dominion Parliament, the writer showed that of *all* the butter and cheese made in the United States, in factory or farm, *about seventy-five per cent* was made in the *private dairies!*

While this is true, however, it does not show that there has not been, and will not yet be, great progress in the direction of manufacturing butter, as cheese is generally manufactured, on the coöperative plan.

The first effort in this direction was the establishment of the **Butter Factory** proper, or what is sometimes called the **Creamery**. This was carried on under the system of taking the milk to the factory, to be there set and skimmed, and the cream to be churned into butter. The skim-milk was sometimes returned, and sometimes made up into skim cheese. This system met with limited success.

What is known as the **Cream-Gathering** (or Fairlamb) System was the outcome of an attempt to secure for butter-making the advantages of coöperation, without the defects found in the early butter-factory system. The advantages were economy of labor, uniformity of product, good marketable quality, and more system in marketing. The disadvantages or defects were, on the one hand, the cartage of skim-milk, on the other hand, its loss, and the injustice to patrons due to inequality of milk values.

The advantages all seem to have been secured; and, with the one exception of variation in values, the objectionable features have been avoided. When this system was established, it was popularly believed that while milk varied in value, cream was so uniform that it could be estimated by cubic measurement without any injustice to patrons. The working of the cream-gathering system has taught that there is no less variation in cream-values than in milk-values.

One important defect, therefore, continued to characterize the new butter-factory system; but it really was a defect only similar to what the cheese-factory had prospered in spite of—or the variation in cream-value.

When it became apparent, however, an attempt was made to overcome this great objection to the cream-gathering system; and with some measure of success. A system has been introduced of testing the cream of each patron and paying according to actual value.

Doubtless the time is not far distant when the coöperative system in all branches of dairying, in both cheese and butter-making, will be characterized by a successful system of testing values and paying according to value.

The Plans of Association are mainly as follows: *First*, the plan of **Patrons' Association**. It is the practice in cheese-making for farmers to form a combination among themselves. They form a stock company, erect a factory, hire the maker, furnish milk or cream, sell the product, and divide the proceeds according to weight of milk, or weight (or estimated value) of cream, as the case may be.

Another plan is that of **Individual Proprietorship**. In this case, some enterprising person or firm erect a factory and buy the milk or cream, and take the chances and risks. This plan is more usually adopted in butter-making than in cheese-making.

Sometimes the proprietor of the factory manufactures the milk or cream into cheese or butter at a certain price per pound. It is usual for the maker to supervise the marketing of the product.

One phase of the latter plan is what is called the **Combination System**. A chain of factories are included under one proprietorship, even to the sale of the product for the patron, who pays a stated price per pound for the manufacture, and realizes whatever the product brings in the market. This system is seen in its highest and most successful development in the combination business, most successful from all points of view, controlled by Mr. D. M. McPherson, known as the Cheese-King of Eastern Ontario.

The main forms of coöperative dairying, at present, are: the CHEESE FACTORY, for making cheese only; the BUTTER FACTORY, for making butter from milk; the CREAMERY, for making butter from *cream* (which has been gathered from the surrounding farms); the CENTRIFUGAL FACTORY, or the creaming of the milk in the factory by the centrifugal machine; and the SKIM-CHEESE FACTORY, where partial or complete creaming for butter is adopted, and the skim-milk is manufactured into skim cheese.

In establishing a factory for butter or cheese, one should be satisfied with nothing but what is best adapted for the purpose. The rules for an ordinary dairy apply here. To what has been said may be emphasized the grand and absolute essential in a cheese factory of a *curing room* in which the temperature may be kept *under perfect control.*

For a **Cheese-Factory Outfit**, for say 400 cows, here follows a fair list of the articles required:—

One each of the following: 3-horse-power Boiler, with fittings; 60-gallon Weigh-can; Tin Conductor; 600-pounds Scales for Milk; Curd-knife of 13 blades, 20 inches long; Curd-knife, with horizontal blades, 6 x 20 inches; Hoisting Crane, Syphon and Large Strainer; Water Pail, extra heavy; Curd Pail; Curd Scoop; Dipper; One Set Milk-Testing Instruments—Comprising 3 Graduated Jars, 1 Lactometer, 12 Cream Tubes; Set Castors for Curd Sink; Factory Account Book, with Slate.

Also, Stencil Plates, 1 each for Name of Factory, and for Dating Cheese; Two 600-gallon Vats, with inside Steam Pipes; Steam-Pipe Connection and Fittings; 16 Cheese-Hoops, best galvanized iron, 15-inch, with Followers; 16 Cheese-Press Screws; Press Frames; Curd Drainers; 2 Stone Rennet Jars; 2 Thermometers. The foregoing, or substitutes therefor, are essential.

There are some other apparatus which, if not absolutely essential, are much needed, and should form a part of every cheese-factory outfit: One Curd Mill; 1 curd rake; one 140-pounds Scales, for Weighing Cheese; Floor Funnel; Wrench; Cheese Tryer; Tinned Cheese-Knife, also Bandagers.

The cost of foregoing would be about $500.

For **Creamery Outfits** (on the **Cream-Gathering** plan for from 300 to 500 cows):—Engine and shafting; two Cream Vats; three Cream Pails; Churn (Revolving Box); one Butter Worker; Weighing Scales (large); Salt Scales (small). The foregoing will cost nearly $600. In the cost of a building, there is, of course, wide margin.

The cans for setting the milk may be furnished free to the farmers, or the latter may be required to pay for them. They will require all to be of one pattern, and guaged for measurement of cream. These cans are not included in above estimate.

A test churn, if required, will add perhaps nearly $50 to the total cost of outfit.

On the **Centrifugal** plan, the cost is estimated, according to ONTARIO EXPERIMENTAL FARM REPORT, at nearly $1,200 the difference being mainly in cost of Centrifugal Machines, which, according to same authority, is said to be $500.

In the choice of some coöperative system for any new district of country, the reader is advised, when possible, to visit the nearest factory, or factories, to observe for himself the practical working of any particular system which is best suited to his locality. Such a visit, previous to embarking in any new branch of dairy agriculture on a large scale, will generally prove a profitable investment of time and money. For making such visits there are now so many opportunities afforded in almost any part of this country, that it is not wise to devote much space in this MANUAL to a detailed description of all the new systems. This remark applies to the cheese-factory, the butter-factory, the creamery, also to the centrifugal dairy, the packing of butter in tins, and to silos and ensilage, &c.

THE **Skim-Cheese Factory**. The object of utilizing the skim-milk in butter factories has led to the making of both butter and cheese together. There are three systems generally employed. One is to skim very lightly (say for from 1 lb. to 1¼ lbs. of butter per 100 lbs. milk), to make a superior article of butter, and a fair quality of cheese from the partially-skimmed milk. The second is to remove all the cream that can be taken off, by whatever method is employed, and made the milk (before it has become sour) into a very poor cheese. The third is to remove more or less of the cream and to replace it with a substitute—lard (or oil)—and make what would be called lard (or oil) cheese.

The making of skim-cheese, in any considerable quantity, say for export abroad, is deprecated almost universally by Canadian dairymen as a course antagonistic to the dairy interests. Space will not admit discussion here of that question. The dairymen of the country are, doubtless, on the safe side in the adoption of a conservative, or cautious policy.

In the **Butter Factory** the milk was usually brought to the factory twice daily, set for cream, skimmed and churned, and the skim-milk or butter-milk was taken back by the patron. Milk was usually set in pails in a pool, surrrounded by running water. The Centrifugal System and the Cream Gathering Systems are gaining ground in the old-time butter factory.

Tinned Butter. For shipment to distant, and especially warm countries, butter is now put up in sealed tin packages. The trade in tinned butter is comparatively new, but it has exhibited a marked development, and is, at the moment, one of considerable promise.

Mr. Dyke, a wide-awake agent, in England, of the Dominion Government, stated in a late report that within ten years this trade has doubled, and that its extension is "practically without limit." Mr. Dyke tells us that the recent expansion is due to the perfection attained in tinning, and he throws out some valuable hints for the successful prosecution of this new branch of the butter industry.

The *first* requisite is that the quality of the butter to be tinned be good. Judging from Market Reports, there is a wide range in the quality of the tinned butter put up in different countries. The prices in one of the importing countries (Cape of Good Hope), ranges from the "American Tins," at about 18 cents, to "Best Danish," at over 50 cents!

Quality, which in any butter is important, doubtless has more to do with prices in tinned butter than in butter in ordinary market form. The tinned butter (even though it be sealed from the air) is subject to very trying contingencies, not only in the long voyage abroad, but after reaching destination—both in hands of dealers, and after having been opened by consumers.

To ensure success in this branch seems to demand attention being given even to the *details of the manufacture.* It would doubtless be a foregone failure to undertake shipping tinned butter picked up by chance, and as carelessly as is done in the general trade practice which unfortunately obtains.

The **Main Factors** in the production of butter that would stand tinning, are *pure milk;* the churning of cream, if not fresh, at least not past the *first stage of sourness;* the washing of the butter in a *granular form,* in water and brine *absolutely pure;* careful, *light,* and *even salting,* with the very *finest brand of salt* obtainable; packing on the *very day of manufacture;* good and *careful packing,* in boxes made of *good tin,* of the size *best suited to the market;* neat, clean and even fancy packages; and *cool storage* from the time of sealing till placed on board the ocean vessel.

While all of these points are of great importance, some of them need to be specially emphasized, perhaps for the reason that they may be disregarded as unimportant.

For instance, Mr. Dyke tells us that from what he can glean, "one of the chief secrets of success is, that to insure its keeping in good condition, butter should be tinned on the evening of the *day on which it is churned;* or, better still, immediately on leaving the churn, before decomposition in the slightest degree can have taken place. Apparently, the non-success of the American and many of the Irish firms engaged in this trade is, that instead of doing this they have re-packed comparatively old, though doubtless good butter." The writer, himself, has been witness to a like mistake in a pioneer effort made in this country to ship butter to the West Indies. The butter was not immediately packed, and there was unnecessary delay in sealing the packages and removing them for proper storage.

As an evidence of the need of carefulness, even to matters seemingly of mere detail, it is said that in Liverpool, during the Summer, the butter is removed from the ship or railway depôt only in the cool of early morning or of late evening.

One important requisite is a variety of *standard sizes* of packages. The following TABLE is a sample of the English Market quotations of a certain manufacture and brand of Danish tinned butter:

Esbensen's "The Cow Brand" of Tinned Danish Butter.

Prices of, in English Market, in 1885 (in PENCE STERLING).

NUMBER OF TINS IN EACH CASE	6	12	20	30	40	60	100	100
POUNDS OF BUTTER IN EACH TIN	28	14	7	5	4	2	1	½
"Salted Quality"	14	14½	15	....	....	....	....	....
'Prime Quality"	....	....	....	....	16	16½	17½	20½
"Choicest Quality"	15½	16	16½	17	17½	....	....	....
"Selected Choicest"	....	....	....	....	....	18	19½	22

It will be noticed that the prices rise with the quality, and are higher as the size of the tins are *smaller.* The small-sized tins have an increased value, especially for hot climates, where butter soon spoils when the can is once opened to the air. Of course the cost of putting up is increased somewhat as the sizes are smaller.

The careful grading of the butter will be necessary, also the adoption of a special name and brand, so as to establish a permanent trade.

It is not quite practicable for the individual farmer to engage in this prospectively profitable branch of butter production, for this line of production involves both a manufacture and a trade. It it an opening for say some enterprising business man who will require to make a sufficient study of the question to enable him to put the farmers in the way of the proper manufacture, and to enable himself to open and develop a successful trade.

It has been thought wise in the interest of Canadian Dairy Agriculture to give these few hints of what are the conditions of the successful establishment in the country of the manufacture of tinned butter. But it must be further said that for the successful development of such industry, nothing else will make so sure and satisfactory preparation as would the spending of a longer or shorter time in the study of the system in some country where it is best understood.

THE **Extent of the Supply.** So far, we have treated the subject mainly from the point of view of QUALITY as a means of INCREASING THE MARKET VALUE OF THE PRODUCT. We have now to deal with another factor in Market Value—that of *Supply*. It needs no argument to show that the extent of supply has an effect upon prices.

This factor is under the control of the individual dairyman chiefly in the way of influencing the extent of consumption. By inducing a larger consumption, the demand is stiffened and prices improved.

The most potent factor in increasing the consumption of dairy produce is that of **Quality**, the consideration of which subject has been anticipated in previous pages, which have been devoted mainly to that phase of our subject.

Another factor is that of **Variety**. The advantages of dairying are leading to a constantly increased production of milk and milk products. All this production must find a market. If the extent of production be unduly heavy, the result will be depreciation in prices. It is for the milk-producers to tickle the palate in many ways, and so induce an increased consumption that will at least keep pace with production.

Milk Supply. It is desirable to increase the consumption not only of milk products, but of milk itself. While the expansion in late years of the milk-supply trade, in towns and villages, has been remarkabiy large, it has far from reached its possible limits. The present system of supply is all too defective to allow anything like the expansion of the milk trade that might be looked for under a condition of things radically improved.

We have only to refer to the two main defects in the present system to sustain our position without further argument. These defects are, first an *indifferent quality* of supply, and unduly high prices. A tendency to improvement in the quality of milk supplied to cities is already apparent; but the progress is far too slow. As to prices, all that need be said is that twenty to thirty cents per gallon is paid in large centres for an article that is sold to factories at seven to ten cents! It is to the interest of every milk-producer, whether he be a butter, cheese or milk dairyman, that milk be sold in all its forms, as milk, cream, butter-milk, &c., and of pure quality, at as reasonably low a price as can be made profitable. The increased consumption to which such a result would lead, would be a surprise to all.

Condensed Milk. In a milk-producing country it is the consumption of new milk which should increase, rather than the consumption of condensed milk. But there is a growing home and foreign market for this article. There is but one factory for condensing milk in Canada, that is at Truro, N.S. It is stated in an official report that condensed milk of Canadian manufacture received a medal at a recent International Exhibition held at Antwerp.

WINTER **Dairying.** There is one line of production not likely very soon to be overdone; while its being taken up by dairymen now engaged in ordinary production would have the desirable effect of increasing consumption. Winter dairying is not likely to be undertaken by those who cannot make summer dairying a success. Winter dairying will increase consumption, for it will furnish winter tables with fresh butter, which will be eaten with greater relish than is the summer-packed butter, perhaps over-salted, and doubtless sharp-flavored. Some of the reasons for engaging in winter-dairying are the following:—

Higher Prices. The very lowest prices are in the summer season, when butter is made in largest quantities. Even the choicest article rules low at that time, because the whole supply is fresh, and the average quality is at its best. After the summer's drouth and the fall frosts have made the supply to fall off, both in quantity and quality, the market stiffens. In winter, even old, salted butter begins to be higher-priced than were the nice fresh rolls of summer.

The quality of winter-butter may be just as good as that of summer butter. The rich butter of summer is a matter of feeding. Summer feeding may be closely imitated by a ration that may be even an improvement upon the sometimes dry, parched feed of midsummer, unrelieved by soiling. As to manufacture, the winter's temperature is under easy control if heat be supplied.

The poor quality of the winter butter, now offered occasionally, made under ordinary circumstances, must not be confounded with the quality of butter that may be made by winter dairying properly so called. In the one case there is the milk of only one or two cows in poor condition, due to the drain of a summer's milking, perhaps not properly housed and fed, and no adequate provision made for care of milk. In the other case, the cow has fresh come in, after a summer's rest in pasture. She is fed well for milk-secretion, and the manufacture of butter being a specialty it is provided for by suitable dairy arrangements, and attended to as a regular work. It need not cost more to produce winter-made than summer-made butter. It is largely a question of feeding, and the saving of manure. Non-productive cows have to be fed in winter as well as in summer. If after a summer's yield they are poor in flesh from the failure of pasture and the drain of milking, they should be fed not only to hold their own, till spring, but to gain enough in winter to go to pasture in good flesh for summer's yield. If there be no profit in such a course, there is no profit in keeping cows at all; for it does not pay to let cows lose flesh in winter, and to appropriate the June and July grass in making it up. In a word, to keep cows for profit, it is necessary *to feed them well all through the year*. Under a paying system of feeding, it does not require very much more feed for cows giving milk in winter than for cows giving milk in summer. If plant-food have value, *no feeding is profitable where manure is wasted*. If manure be not wasted, extra food, when needed, may be given to profit, *whether it be for winter feeding or summer feeding*.

The milk-yield under a proper system of winter dairying, will be greater than under the system too likely to obtain in summer dairying. Cows that are non-productive are too likely to be underfed in winter and so they are poor in spring. But when they come in at the close of a summer's rest in pasture, they are in good condition for milk-giving.

Under a proper system of dairying, it could not be said that farmers in cold countries have to work all summer to make up for the loss in feeding stock all winter. It pays some farmers to feed cows extra in pasture. It pays no farmer to under-feed cows, in pasture or stable. Winter dairying will prove to the dairymen that there is profit in good feeding, provided the manure be well saved; and no profit in allowing cows to fall behind for want of feeding.

Winter dairying divides up the year's work more evenly. In summer dairying, the dairy work is crowded into the months when the farm work of the year is most pressing. This over-taxes the farm hands, or perhaps lays too many duties upon the women of the farm; and the dairy work, after all, is more or less slighted. If hired help be required for the dairy, it may be procured cheaper in winter than summer. All manufacturers who are rushed by summer orders, are well pleased to get winter contracts. Dairymen as manufacturers ought also to be regardful of the economic laws under which they work for profit.

The question of profit in winter-dairying is set at rest by the facts of experience. The Danes have entered upon winter-dairying *as a people*, and have found the change to their advantage. It does not follow that every nation could do the same thing; for the conditions would be affected by so general a change—and not all may have Danish markets. It is certain, however, that as many may enter this promising field as will be required to supply, at least, the home winter's consumption with winter-made butter. If this be so, it seems a mistake for so many dairymen to spend the winter more or less idle, and to crowd so much work into an all-too-busy summer,—especially in making goods in summer that are not wanted till winter, and which would bring readier sale and better prices if made when wanted—to be offered fresh instead of stale! All who practise winter-dairying find it profitable.

The **Essentials** in winter-dairying are, first, the necessity for the cows to come in in the autumn—say between September and November. The milking season should begin when prices are beginning to be good, when summer's drought has passed and butter is easily made, and will be firm and marketable, and when the other work of summer will allow one to give the dairy work due attention. This will be in September in most cases. In some cases it may be the latter end of August, or beginning of October.

The second essential is feeding. It will be necessary to make the winter's feed as nearly as possible in character like nature's—the summer grass of nature—which produces the ideal butter. Early-cut, well-cured grass, instead of dry stalks; succulent foods, like roots and ensilage, to make up for the partial dryness of the hay; and, to some extent, concentrated foods, like grain, meal, oil-cake, etc., to make good strong feeding and rich manure.

ARTIFICIAL Butters. The law of demand and supply has been complicated by what the farmer very naturally believes to be an unfair competition. Legislation in regard to oleomargarine has made it unnecessary to take up much space in the discussion of that vexed question. Oleomargarine is now prohibited by legislative enactment.

This action was doubtless a wise one and can be supported by many reasons. While there may be something to be said against it, such action was at least nothing worse than wisely leaning towards the safe side. A mistake on this side, if it has been made, is not serious, and in the future may be remedied; a mistake on the other side would become very serious, and extremely difficult, if at all possible, to remedy. The interest of the whole farming community was in apparent jeopardy; and being the most legitimate and important, the longest established and most permanent, it had a first right of protection. On the other hand, there were no opposing interests established at all comparable to the former. The whole public desired protection against the new thing which, at the best presented a forbidding aspect.

As things now stand, any injustice—if any has been done—may be remedied in time. If it be that there has been temporary injustice in the meantime, the interest which has been outlawed *has itself to thank* for what has been done. Had it come before the public as a legitimate industry and with apparent wish and intention to be honest, it might have been better received. But it came here as a counterfeiter and a thief, and boldly claimed the right to remain under the very protection which law is supposed to afford not for but *against* fraud!

This now humiliated interest had no hope of existence, except under the semblance of the thing which it counterfeited. It had no chance of life unless it stole another's trade-mark, or birthright. Not to be forbidden such theft were an outrage upon our much-prized common law. It is true that it claimed to be able to exist, and hold its own, under its own name and countenance; but it has failed to meet the burden of proof which, in view of its past history, always under a disguise, was rightly laid upon it.

An excuse has been made for the deceptive character of artificial butter, in the claim that in natural butter, too, there was deception—in the use of an artificial coloring. Such excuse is much like one person claiming a right to pass under the name of another person, because that other person used some deception in his make-up. A parallel would be found in Mr. Chips claiming the right to personate Mr. Oak, because Mr. Oak improved his appearance by deception—say by wearing a wig, or by dyeing his hair! If ever the industry of manufacturing artificial butter secures a firm, sure and permanent foothold, it will be, doubtless, after it has proved itself honest—reformed, it may be, by Act of Parliament.

Now that the law has done the best that could be done to protect the dairyman, there remains something to be done by the latter. Protected, as he is, from competition of a substitute for his product—one that is possibly wholesome—it is both his opportunity and duty to give the consumer an abundance of a genuine article of real merit. If the dairyman would like to keep the substitute forever out of the market, he should supplement Government action, by making so good and wholesome a butter that there will be no excuse for the encouragement of a substitute.

PART II.

LESSENING THE COST OF PRODUCTION.

A**GRICULTURE** is the basis of our national prosperity. Every branch of agriculture is important, for the simple reason that it is a branch of agriculture.

Dairying, in its importance is second to no other branch of agriculture, and it perhaps stands alone. A few reasons for this may be given :—

Dairying is a solution of a NATIONAL PROBLEM. The virgin soils of the New World and the peculiar conditions of early settlement, encouraged a mode of farming that has been in the direction of soil-exhaustion. The necessity for constantly returning to the soil the plant-food which is taken from it, as the only means of keeping up the productive power of the land, has not been recognized in the New World as it has been recognized in the old. This has gone on so far, that it has become a serious problem in the older settled portions of both Canada and the United States how to make the farm profitably productive.

The changes brought about during the last half-century of unparalleled progress, have complicated this question. Values once local are now general. Communication is speedy, transportation cheap, and old-time assurances and margins are eliminated by a world's competition at one's very door. Prices are now fixed, not by the small surplus from one's own worn-out farm, but by the whole production of the country ; and the advantage is all on the side of the productive lands. This, in connection with the opening up of the great North-West, intensifies the problem of the profitable working of worn-out farms in the East.

Dairying is one of the few specialties in farming which presents a promising outlook to the many farmers who cannot continue longer as they have been doing. Says Prof. Arnold :—

"Dairy farming is most appropriate and inviting for the restoration of a vast extent of land thus reduced. It stops at once exhaustion, but does not stop income. It brings good returns from the first. Forage crops grow well where grain crops pay poorly. Seeding down to grass gives time for air and water, heat and frost, to gradually unlock the tenacious compounds which hold the mineral elements of plants as with a firm grasp, and lets them loose for the rootlets to feed upon, or to accumulate in the soil for future use. It gives time for the absorbent properties of the soil to take in elements of fertility from the atmosphere, from the snows and rains, and from the dews of heaven. In this way a farm that has run down may be made to grow rich, and a rich one richer."

Stock-raising shares with dairying in this regard. Which of the two is of the greater importance it is not here necessary to show. They are kindred branches, each possessing peculiar advantages. There is great advantage in prosecuting both industries ; and both are to be valued as a means of giving heart to the worn-out soil that now wants to be more than tickled to be caused to laugh with a generous harvest.

The growth of the dairy industry is one of the features of this age of progress. In a single generation it has emerged from the humble precincts of quiet home-production, and one might say home consumption, to take its place among the leading industries of the day, ranking second to no other, either in industrial or commercial importance.

There is reason to believe that this youthful giant has not yet attained full growth. Everything points to a still further expansion of its proportions. Better methods will improve the quality, and the supply of finer products will lead to increased consumption.

For any who realize the force of the foregoing remarks, and purpose taking advantage of the possibilities of profitable dairy production, there is a further consideration which deserves some attention. It is the fact that a **Stiff Competition** is inevitable.

The advantages just set forth, in mere skeleton form, have not been unnoticed by others. So long ago as in 1868, Mr. Mitchell, in one of the always charming "Ik-Marvel" Series, came to the conclusion that it was to dairying he must look if he would make profitable his then recent purchase, which he calls "My farm at Edgewood."

That scientific and veteran dairyman, Prof. Arnold, in his clear, terse style, shows the trend of this consideration, in 1879 :—"An approximate certainty of uniform products and prices, a diminution of the severe labor of grain-growing, a cessation of the exhaustion of the soil, and the retention upon the farm of nearly all its fertilizing material to aid in restoring an impoverished soil to a rich and productive one, are considerations which must in the future, as they do now, have great weight in leading intelligent farmers to exchange the plough for the milk pail. They are sufficient to warrant the inference that dairy-farming is destined to follow in the wake of the grain-grower, and, sweeping over the wide expanse of his westward march, to restore the lost fertility and bring back to productiveness the vast extent of land which his destructive habits have made poor. They will make dairy farming preferable to grain-growing when the profits of dairy products shall fall to those of grain growing, and even below."

Mr. E. D. Gilbert, of the Utica N.Y., Board of Trade, in 1885, at Stratford, Ontario, expresses the same idea :—

"And as our population grows denser, and larger numbers engage in the dairy business, the mere force of circumstances will compel our dairymen to improve their herds and increase their yield."

There is the same activity in Europe. Everyone has heard of the special efforts put forth by Denmark, successfully to press to the front, in this line of competition. The example of Denmark has led other countries to aim at the same result. In a French translation of a very elaborate work by Dr. Fleischmann, we read the following, written from the point of view of Germany :—

"It is enough to show one aspect of the economic development of Denmark, Sweden, and Finland, during the last ten years, to see how the agriculturist of these countries has been led by the extension of the means of communication, and by the excellent advantage such extension has given to dispose favorably of milk products, to make the dairy industry the basis of their operations.

"From this result has followed an improvement in cattle-growing, and this in its turn has exercised a beneficial influence upon agriculture as a whole. In Germany, and in many other countries, the important means which lead to the proper development of this industry are not sufficiently appreciated. It is now time to devote ourselves to the object of attaining in this race to the point already gained by other nations; we cannot allow ourselves longer to remain behind."

Already is this competition being felt in the country to which the world looks for a market for dairy products. *Bell's Messenger* gives a gloomy view of the outlook for the British producer :—

"Dairy farming has been one of the great branches of rural industry held out as the anchor of the British farmer. But the ogre of unlimited and unregulated foreign competition is battening on us as voraciously in this as in all other productions we may engage in. Read the report from the Chester cheese market. It is no longer to be boasted that the finest qualities of Cheshire Cheese are independent of the American trade. Fine qualities dropped quite £1 per cwt., common sorts sold for 20s. to 25s., and very inferior had to be taken home again to rot. This is a blow to the supposed happy agriculture of Cheshire, of which the severity cannot yet be estimated."

These quotations have been given, not because of an intention to treat the subject exhaustively; but rather to emphasize two points that were so important that they at once give this MANUAL its *raison d'etre* and its character. These points are the *possible advantages in dairying*, and the *certainty of competition*. The fact that there is a grand opportunity for somebody, and that many are alive to the fact, suggest the need for one to be early in making progress if he would succeed in getting to the front.

The key-note of this work is an aim to help any who would make such advance. The opening page called attention to this competition, and suggested, as a means for meeting such competition, the two prime necessities; *first*, an effort to *increase the market value of one's product; second*, an effort to *lessen the cost of production*.

To the former essential to successful competition, or to profitable dairying, the first part of the MANUAL was mainly devoted. In this, Part II, our attention will be directed to the next important essential; and this introduction cannot but emphasize the importance of the **Cost of Production** as a factor in profitable dairying.

But while both factors are in some sense of equal importance, they are not equally pressing. In the face of competition as it exists, the necessity for the improvement of quality is immediate. The necessity for cheapening cost of production is comparatively remote. If the quality of our butter be not soon improved, we are likely to wholly miss the opportunity at hand of permanently establishing an industry of butter-production for export. On the other hand, the early radical improvement of the butter quality will be followed up, under the pressure of competition, by cheaper production.

The lack of space due to the more exhaustive treatment of the quantity-phase of the subject obliges the writer to leave out a mass of matter bearing upon this other phase—matter already prepared. These considerations will explain the incomplete and somewhat disconnected character of what follows.

The Reasons for Cheaper Production. It is *not* stated here as one of the reasons for cheaper production that dairymen get too high a price for their products; for far too many of them do not realize all that dairy products should bring. Indeed, one object set forth for improving quality was that of better prices. There are several reasons for cheaper production.

1. The **Present Cost** of production is **Unduly High.** This is not because the farmer is a monopolist, or a union-man, and receives too much pay for his work; nor are his profits too large. It is not because the farmer does not work hard enough, and not because he has not sufficient interest in his work. The cost of production is too high because the methods employed are not always the best. Every intelligent farmer knows this to be a true statement, because he has the evidence daily before his eyes. It is true of farming as it is true of any occupation, that so long as there is chance for improvement, it may be said that the methods employed are not the best. It is more true of farming than of most occupations that there is chance for improvement. This statement is no libel on the farmer; it has abundant explanation in the fact that there is no other occupation which affords so wide a field for the application of energy and intelligence.

It is a shallow thinker who blames the farmer for the comparative lack of perfection which has been attained in general farming practice. Science already has almost better control of electricity, whose acquaintance it made yesterday, than it has of the phenomena of plant-growth, which was one of the wonders that greeted an astonished Adam. The genius of a Lawes or a Gilbert, who spend their years in the slow questioning of nature, and find their lives almost too short for the slower answering, does not pale before the brilliance of a Bell or an Edison, who make us wonder with the almost human achievements of the thing that Franklin's kite first introduced to men—the thing which men harness into their service and call electricity, without knowing what it is!

There is chance for improvement by the dairyman all along the line, from the selection and feeding of his stock to the manufacture and marketing of his dairy products. So long as this is true, it may be said that the cost of production is unduly high.

Second. Cheapening cost of production will **Increase Profits**. Prices are only indirectly and remotely affected by cost of production. The price of an article offered in the market will be determined by its quality, or by the supply in the market, and the buyer will not question whether it cost much or little to produce it. The producer improves the quality of his product because such improvement will make the article sell better, and at a high price, and so increase his profits. For a producer to make the cost of production less is to accomplish the same purpose—increase his profits.

Third. Cheapening cost of production is a **Necessity of Competition.** This is one of the most cogent of the reasons for improvement in the line of reducing cost of production. There is a great activity everywhere, and the chances are that increased production will lower prices. The dairyman has it in his own hands to be prepared for any such result, and still maintain his present profits, or it may be, increase them in spite of lower prices. He will do it by producing at less cost, and in no other way.

MILK is a wonderful compound, and possesses many and varied qualities. It is a *perfectly-balanced* food; not for sustaining full-grown life, as it was intended to promote *growth*, but for the young, to the needs of which it is perfectly adapted.

Milk is of *variable character.* (*a*) It is different in *different species.* In the milk of the ass in its normal condition, the butter is only about one-ninth of one per cent.; in that of the ewe, the butter is over four per cent. (*b*) Milk varies in *different breeds* of the same race. This difference is in both butter quality and cheese quality, and in other respects. The ordinary and normal variation, between breeds, of the butter in milk is from less than two per cent. to over seven per cent. (*c*) There is a difference also between *individuals* of the same breed, and even of the same family. This difference is more in *quality* than character. (*d*) There is also difference in milk at different *distances from time of calving.* The milk of the cow undergoes a change from first to last. At first it is medicinal in character, adapted only for the young animal, and is unfit for human food until, sometimes, four or five days after calving. In its later change, it becomes richer in butter, but depreciates in general butter quality. It is claimed that all the constituents of milk being at their maximum during early stages, the milk at that time has "character," and will produce quality, or the "full natural rich flavor, odor, color, and texture."

The character and quality of milk is affected by many *controllable* influences:—

(*a*) The *breed* of one's herd is subject to at least partial control. New blood may be gradually infused into a herd by the *choice of a male.* (*b*) The *value of the individual animals* may be raised by careful *selection.* (*c*) The influence upon quality of the *distance from time of calving* upon milk and butter may be partially controlled in fair-sized herds, by providing always for the presence of one or more new-milch cows, the milk of which it is believed give "character" to the whole yield of the herd. Prof. Brown tells us that one gallon of new milk will give character to twelve gallons that do not possess it, and consequently the number of incoming cows need not exceed one to twelve. This is a point of importance to the *advanced* dairyman, rather than to one who has not yet improved in foundation methods of general care, feeding, &c. (*d*) The *physical state* of the cow, and even the *mental* state, are also under control. Health and quiet, of course, are favorable; ill-health or excitement are decidedly injurious. Fear, fright, worry, solicitude, pain and hunger—all more or less under control—at once make their plaint in the milk. (*e*) The factors of food and drink are rivals with that of *breed,* in their influence upon the milk. It is the raw material with which milk is made, and the cow, however good use she can make of raw material, can do nothing at all without it. Water constituting nearly ninety per cent. of the milk and having a large part in the whole physical economy of the animal, makes itself felt upon the milk, according as it is pure or impure, abundant or scant. (*f*) *Temperature* is a more controlling influence than is generally supposed. Suffering from winter's cold, the productive energies of the cow are withdrawn from full milk-production, to saving the system from the harsh effects of the cold. On the other hand the influence of undue heat—the hot sunshine of summer, unrelieved by shade, has been proved by careful test to be unfavorable to the milk.

Purity of Milk. Milk has its value as a food, or as raw material with which to make food. Its character as a ready vehicle of impurity and disease, makes it necessary that it be *pure.* Milk may become impure either in the cow or after being milked. In the cow it is influenced by the causes already mentioned—food, water, ill-health, etc. It is susceptible, also, to taint both in the udder and after being drawn from the udder.

"If a cow be fed on oil-cake, its milk becomes unfit for the table. The milk of a cow fed on grass watered with sewage becomes sour and fetid in a short time.. If a piece of putrid meat is placed beside a basin of milk, the milk will soon be found to have both the smell and taste of carrion." (McEachren.)

Unhealthy cows, impure food or water, uncleanly surroundings, impure air, will produce imperfect or impure milk.

The milk of a sick cow will sometimes communicate the disease of the cow to the person using it. Milk from a cow suffering from *tuberculosis* will cause consumption to persons using it.

Typhoid and scarlet fever have been caused or spread by impure well-water, used either to water the milk, or to wash the vessels!

"Blue milk is due to an impoverished or ill-fed cow; red milk to the cow eating madder, hulls of peas, and any of several wild plants; rotten milk to bad water, improper food, or dirty premises." (McEachren.)

The *processes* of manufacturing milk into its products are unfavorably affected by defective milk, and the products of bad milk are always inferior if not worthless. One lot of tainted milk will affect a whole vat of pure milk.

Creaming Quality of milk. Owing to various reasons, such as the variation in size of globules, and in the extent of the adhesion of caseous matter to globules, all milk does not throw up the same proportion of its cream. As a consequence, the milk of some cows will give up nearly all its butter, and will leave a poor quality of skim-milk, the milk from other cows may be nearly or quite as rich in butter, and yet not readily give it up. The skim-milk from the latter would be comparatively rich. This quality of giving up its cream readily and perfectly is called *creaming quality*. Since the value of milk for butter-making depends not so much upon the amount of butter the milk contains, as the amount that can be produced from it, this creaming quality is very important in butter cows. But it is of less account in cheese-making, or for household use, because it can be wholly utilized in the latter cases. Indeed, a poor creaming quality is an advantage in cheese cows, or in cows whose milk is sold for household uses.

Churning Quality of Cream. Few dairymen realize how much difference there is in cream in the time required to "bring" it into butter by churning. Not knowing the difference, one does not know the loss incurred by not providing for that difference. It is a common impression that when butter has "come" in the churn, the butter has all churned that can be churned. Major Alvord found that one of his cows, fed on dry feed, gave the usual quantity of milk, and *less than half the usual quantity of butter*. He churned 37 pounds of this cow's milk four different times, and obtained butter at each churning, in ounces, as follows: 1—12½; 2—12; 3—5½; 4—1¼. Total, 31¼ ounces.

Now, it is not practicable for dairymen to churn butter-milk. Even if there be a considerable quantity of butter in it, it is difficult to recover it. It is better to provide against the loss by such means as thorough ripening of cream; and the sometimes heating of milk which is slow to come, as, for instance, that from cows long in. Let it be heated before setting, and tests made to learn with what gain. Beyond this, one may in some degree avoid mixing different lots of milk which refuse, in churning, to "break" at the same, or nearly the same time.

The following conditions are favorable for butter coming quickly in churning: A large cream globule; the cream or fat globule free from caseous attachment; cream in the early stages of the milking period; cream from the feeding of succulent food, etc.

Skim-Milk. Milk from which more or less of the cream has been taken is said to be *skimmed*, and is called skim-milk. The value of skim-milk as compared to that of the new and whole milk depends mainly upon two things: *First*, upon the quantity of cream or fat that has been removed from the milk; and *Second*, upon changes that have taken place in the milk during the process of separation.

There is only one constituent of new milk taken from it to depreciate its quality. It is the fat, or butter. The other solids remain in the milk in about the same proportions as before. The removal of the fat of course lessens the proportion of food in the milk; but the loss of fat does not make it a badly balanced food. There still remains in skim-milk enough to make it valuable as food. The removal, with the cream, of other solids than fat, of course make the total quantity less; but it does not affect the proportions of the other solids in the skim-milk.

The *changes* which milk undergoes in the process of manufacture affect the value of the skim-milk sometimes more than the loss of its fat. This change sometimes means the difference between milk fresh, sweet and warm, and milk old, sour and cold. The value of skim-milk, then, depends upon how much change of this character it undergoes. The process of cream separation has everything to do with the amount of loss by such changes. By the old system of open pans, the milk in summer sometimes suffers in all these respects. The loss of heat under any system, provided the milk be sweet, may be easily remedied, of course, by warming the milk artificially. The system of deep-setting in ice or cold water, causes the milk to undergo only one change—it becomes colder; and the centrifuge causes almost no change at all, unless the beneficial ones of aerating and cleansing the milk.

In calf-feeding, the main requirements are that skim-milk should be fed warm (like new milk) and ought to be fed sweet.

MILK-SECRETION is a response to a natural pleasurable sensation; similar to that in satisfying the appetite for food. This pleasurable feeling is a provision of nature to ensure the supply for the needs of offspring; and it is by taking advantage of such provision that man has secured for himself a bountiful milk-supply.

It is by a **Stimulation** of the natural power of milk-secretion that man has developed the natural power, thus increasing and prolonging the milk flow, to suit his own purpose. The abundant yield of the domestic cow, therefore, is not of a purely natural state but is rather an artificial development; it has been artificially induced, and must be artificially kept up.

This is something of practical importance. It is easy to fall into a belief that the milk yield of the cow is something given out of pure natural cow generosity. All careless abuse of a cow by its owner, if the owner be at all careful for profit, must spring from such an impression. It will *pay* to remember that the comfort of the cow has more than her generosity to do with our milk supply.

It is because of this fact that many things which seem trifling have an effect, either for good or bad, upon both *quantity* and *quality*, not only *immediately* but *remotely*. Frightening or hurrying the cows, harsh treatment, pain, hunger, cold, fear, disappointment (as when failing to get a customary mess), or general discomfort,—*any* such disturbing cause will check the milk flow.

The sluggish habit, the timid disposition, and the dependent nature of the cow must be favored, if one would rather encourage a full yield. All her movements must be in natural, quiet and matter-of-course order, so as to be of the least disturbing character. Dog or man must well understand this before either is fit to stand in the presence of this gentle creature.

Especially when her milk is being drawn, the cow should be in a perfect state of repose and contentment. The milk is not all in the teats, nor even in the udder—made to freely run out, as it were, by the opening of a valve. Rather, it is when milking that the stimulation of the very act promotes the greatest secretion of milk, as well as the immediate flow of what has been already secreted. So, while the cow is being milked, nothing sudden or unusual should be allowed to attract her attention. She must not have to wait too long to be milked, and while being milked should enjoy the operation.

Kindness. The milker who would make his service a profitable one must needs have in his own breast not a little of the milk of human kindness.

Discomforting Ailments. Some of the best cows have habits that are annoying to the milker, and which sometimes provoke ill-temper on the milker's part. Rather than indulge in such ill-temper, to one's own grievous hurt, and to the injury of the cow, one should exercise his best intelligence to find out the *cause of the discomfort.*

Sore Teats are a prolific cause of cow discomfort. Doubtless long finger-nails are a frequent cause of sore teats. Finger-nails dig into the tender teats, and cut them. This is especially true when the cow is first milked after calving, and before the teats have toughened.

The **Remedy:** Keep the finger nails pared short; and endeavor to milk without digging the ends of fingers or nails into the teats. Owing to variations in relative size of hands and teats, and to want of strength in fingers, and hard-milking qualities of cows, one cannot always help digging into the teats with the ends of one's fingers; but where it can be done, it is better to *press the fingers flat against the teats.*

Switching the Tail. This habit is naturally a legitimate one of self-protection. It sometimes becomes, however, with some cows, an established habit of pure wantonness. The writer has a cow with such a vexatious habit, and he blushes to remember what exhibitions of unmanliness in temper the exercise of that habit has caused. The results of such manifestations of temper conduced to considerable discomfort of the cow, led to somewhat strained relations between milker and cow, and did not contribute to milk-production by the cow, or equanimity on the part of the owner. Now all is changed. The greatest of harmony exists. The cow is a great pet of the once provoked milker, and the latter appears to be one of the cow's favorite milkers. Space will not admit showing all the advantages of this changed state of affairs, but they are great; and all was brought about in a simple manner:

A stout string was fastened by one end to a post that stood at the left flank of the cow, and by this string was the tail of the cow tied up short, by a single knot, but so securely that it could not get free. At first her ladyship demurred, but now she expects it as a matter of course, and submits with all grace, and is apparently pleased to see the milker, whose now unfailing good temper is quite to her liking!

This instance is given not only as instructive for such particular cases, but as an illustration of what may be done by the exercise of a little ingenuity in the treatment of the cow, having in view the prevention of disturbing causes.

When a cow switches her tail only because she is bothered by flies, it would be cruel to tie up her tail, and allow her to suffer the discomfort of flies. In such case, one may throw a light blanket, or net, over the cow; or wear a protection over the face, similar to that worn by bee-keepers.

Suitable **Shelter** would be a protection, during milking, both against flies and from severe weather. **Milking-Sheds** have been adopted to the satisfaction of many. A few cows sometimes may be milked when standing loose in open field, or yard, but if there are any risks of the cows annoying each other, or being from any cause fretted or disturbed, it will help to lessen the cost of production to securely attach them in their respective places to be milked.

Regularity is of economic importance with all animals, but with none other so much as with the cow. The disposition of the cow to yield her milk, the character of milk itself, subject as it to changes, all demand that everything be done, as much as possible like clock-work. In a well-constituted dairy, each milker will have a definite number of cows for each milking, and will milk them at nearly the same hour each day, and always in the same order.

Frequency of Milking. The distention of the udder tends to check milk-secretion, while the removal of the milk tends to promote secretion. This being true, the shorter the intervals between milkings the better. Again, the less time the milk remains in the milk-vessels, the richer it is in fat, and the purer it is. The first-drawn milk is the poorest, and the last drawn milk is the richest, because the first has been long secreted and the last fresh secreted. All these facts point to the advantage of frequent milking.

Twice Daily is as often as cows can be milked conveniently in most dairies. Here there is especial need for regular hours and even division, for any irregularity decreases one period at the expense of lengthening the other. Twelve hours between milkings is itself almost longer than is consistent with a large yield of *good* milk. It should never be longer.

There are, indeed, some exceptions to this rule One is when an interval is specially unfavorable, in which case it may be slightly shortened, even at the expense of lengthening the other interval. For instance, in "dog days" it might do to have eleven hours between milkings during the day period when the cows are grazing under a hot sun, and thirteen hours for the night interval when the cows are most of the time in repose, and cool and comfortable. Too often this is reversed; the cows being milked at 5 a.m. and at 7 p.m. So, when through the heat of day they are in active search for food, they are required to secrete milk, and to carry an over-distended udder, while at night, in comparative repose, the udder is distended less than its full proportion. Better, therefore, to milk at 7 a.m. and 5 p.m. Again, the interval which gives the largest flow of milk might be shortened.

Thrice Daily. Some dairymen object to milking thrice daily, for the reason that the practice is believed to have a tendency to cause the milk not to be retained in the udder. The writer does not give weight to this objection. It is usually only a heavy milker, with a distended udder, that loses her milk. She is more likely to lose it when twice milked than when thrice milked. There are, however, some decided advantages in thrice milking. It will secure a *larger quantity of milk*, the milk will be *richer in fat*, and it will be *purer*. This is especially true where noon milking is practised during "dog days." The trouble is not in the *weather* and consequent difficulty of churning, but in the *condition of the milk as it comes from the cow*, sometimes not fit for immediate use, not to speak of use as raw material of manufacture. Milking at noon would do away with much of the trouble experienced in mid-summer, and make it unnecessary to make poor cheese of milk that will not make good butter.

Twelve or fourteen hours, even under favorable conditions, is as long as milk should remain in the milk-vessels. Twenty-four hours is enough to make milk hardly fit for human consumption. Fourteen hours on a hot summer-day is worse, probably, than twenty-four hours in the cool autumn.

Another advantage of milking thrice daily is that it **Stimulates the Milking Habit.** It will increase not only the immediate yield, but will help to prolong the period of the yield, and will doubtless do something towards perpetuating the milking qualities of offspring. Advantage may be taken of this stimulating effect, to bring up the milk flow after a temporary falling off.

The practice of thrice milking, therefore, may be employed as an **Occasional Practice**, as in the two instances noted—during summer heat, and at times of falling off in yield. In such case it is advisable that one of the three periods between milkings be a *full period* of nearly twelve hours; this because it is necessary for the udder to be distended every day, so that when twice milking is recurred to, the milk-vessels will be equal to the pressure upon them. With this precaution, there is no difficulty in changing twice to thrice milking, from time to time to suit the convenience and needs of the dairy.

Regularity in the noon milking, with its shortest period between milkings, while desirable, is *not nearly so necessary* as it is when milking twice daily with its long periods. The writer strongly advises an occasional trial of this practice by those who can conveniently make it. There are many farmers with small herds who would realize a decided profit by practising milking thrice daily, not occasionally, but through the flush of the season, from spring to fall.

Complete Milking is another most important requisite. The first drawn milk is sometimes too poor to be worth saving; the last drawn is extremely rich with the finest quality of butter fat. The average milk of the first and last pint drawn from eleven cows gave 15 per cent. of cream. The first pint drawn gave only 6 per cent. of cream, or 60 per cent. less than the average; and the last pint drawn gave 32 per cent., or over 100 per cent more than the average! More than this, the specific gravity of the *cream* showed that the last-drawn milk was proportionately richer in butter fat. It *pays*, therefore, to take a little time to draw *all the milk*, for the value of the milk obtained.

Again, the stimulation from thorough milking promotes milk-secretion, while leaving milk in the udder actually checks milk-secretion, and is one of the speediest ways of drying the cow. This consideration is of more importance than the one previous. It will *not pay* to allow *any* milk to remain in the udder.

Rapid Milking. The quicker milk is drawn, the more freely it is secreted by the cow and given down. Any check to the flow becomes to the comfort of the cow a disturbing factor which the cow resents. Much will depend upon the disposition of the cow, but it is more or less true of all cows that the milk will be yielded more freely by being rapidly drawn. Especially should the flow be *continuous*, and not fitful. See that everything is ready before beginning, and do not allow any interruptions during the period. If one need to rest, let the rest be taken passing from one cow to another, and not between the beginning and finishing of milking.

Influence of the Cow. The physical organization of the cow has much to do with the character of the milk, in respect of its creaming and churning, as well as of other qualities. At the New York Experimental Station the milk of two Jersey cows was tested daily for a number of weeks, to determine its churning quality, or what percentage the yield of butter would be of the fat in the milk. The fat was determined by analysis, and the butter by churning the whole milk. The result showed that one cow gave nearly 50 per cent. more butter than the other cow, in proportion to the amount of fat in the milk. Taking the fat in the milk as 100, the average yield of fat in the one case was 95 per cent., and in the other case 66 per cent. !

These cows were both the same breed—Jerseys—and kept under exactly similar conditions. There were other marked differences between the two cows, such as color, texture, grain and melting point, and it was clear that the difference was constitutional. This creaming quality of milk, due to the animal constitution, is under control, in a measure, by breeding, but, of course, is not under immediate control. There are cows the milk of which is fairly rich in cream. Take two cows, the milk from both of which is equally rich in butter. Let this milk be set for cream-rising under exactly similar conditions. Will the cream from both be of equal value? If the milk of both cows had an equal creaming value, yes; if it had a different creaming quality, no. Reliable test of the milk of cows has shown that two samples of milk may have the same percentage of fat, or butter, and their creaming value differ 50 *per cent.*

From these facts we learn that the value of milk for butter-making does not depend alone upon the richness of the milk, but upon the creaming quality as well.

The Cow a Machine. To say, as often it is said, that the cow is a machine, is to very imperfectly express the truth. The cow is in one sense a machine, and in many senses more than a machine. Like a machine, she must needs be supplied with raw material for the production of a finished product; and the quantity and quality of the thing produced will depend both upon the character of that machine, and of the raw material supplied.

But in other important respects the cow is not a machine. She is not kept running by the application of an outside force; for she herself consumes a part of the manufacturing raw material, in supporting motion, or life and action. She cannot be stopped and set aside to lie idle when raw material is scant, or when she is not producing. She must be constantly supplied with valuable raw material, whether she produce or not, and the only profit there is in furnishing a supply comes of the product of the *surplus*, over and above what she uses daily for the supply of force and waste. Because of so much of the raw material being required for the machine (leaving only a part of it to be turned into a marketable product), this product must be a comparatively expensive one, and consequently of good quality, and must have comparatively a high value in order to make production profitable.

Again, the cow is not like a machine that can be broken with impunity and mended to order. She is a created, living and delicate organization, wonderfully constructed, and has certain natural wants that are imperative.

Again, the time of her existence has perhaps shorter limits than a machine has, and she can be replaced only by her like, produced not mechanically but by herself. She is the only mother of other machines to take her place. The character and value of these other machines—her offspring—will not be an exact reproduction of herself, but will vary, it may be in the line of improvement or it may be in the line of depreciation. While the keeper cannot manufacture this new machine, it is in his power, by virtue of his management, either secure improvement upon the parent, or to suffer loss.

PEDIGREE and Performance. The value of an animal depends upon its individual qualities as a producer, and its power of transmitting these qualities to its offspring. There are two principal means of determining this value. The main one is to make a record of what the animal has done. Animals being kept for their produce, the ultimate test of all values in animals is production. Some idea of the productive qualities of an animal may be obtained from its appearance and family history, but the surest test is the *actual* performance.

Another means of determining the value of an animal is by reference to the record of *family* performance. This latter value is based upon the fact that the quality of an animal, and its power of transmitting its quality, is dependent upon the qualities and powers of its ancestry. A history of such ancestry is called *pedigree.*

Neither one of these means of determining animal value is sufficient of itself. The performance of an animal, while it is the ultimate test of its productive value, is only a partial test of its powers of transmitting its individual qualities. A stronger assurance is found in pedigree.

Both in the raising and purchase of stock it is necessary to estimate the probable qualities of animals before the record of individual performance has been made—even before birth. Pedigree affords a strong basis for such estimate.

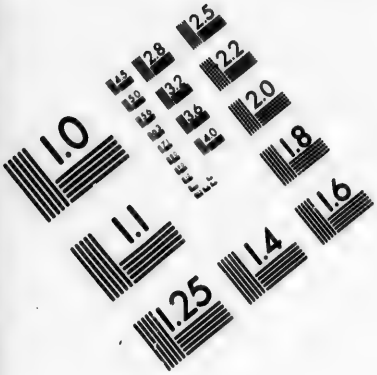
On the other hand, pedigree has absolutely no value that is not based upon performance somewhere. If there were no merit in the family to which an animal belongs, the pedigree of a century would be worthless.

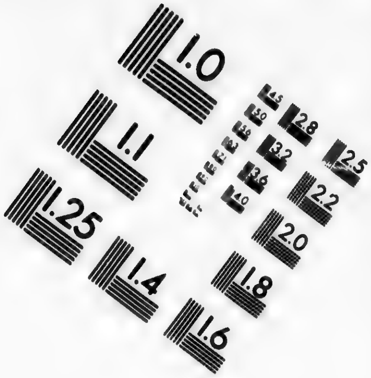
This being true, it follows that the value of all performance would be enhanced by a pedigree record; while pedigree to have any value should have associated with it the merit of excellence in performance.

There is too much tendency to forget how closely the two means of estimate are associated,—to over-estimate the one and undervalue the other.

There are those who think of pedigree as something fanciful, and of no *practical* value. There are others who set too much value upon a mere history of names—because it is called pedigree and has had some remote association with real or supposed merit.

But there are many who more justly appreciate both values. These are wise farmers, who will pay an extra price for an animal for the two reasons that he has the appearance of a superior animal, and possesses a creditable pedigree. Then there are breeders who have large investments in the pedigree side of their animals, who yet are wise enough to demand that pedigree be supported by performance. In this connection, it is gratifying to quote the





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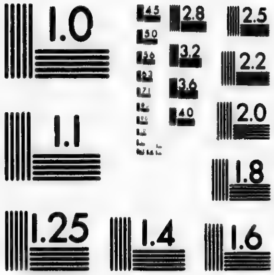

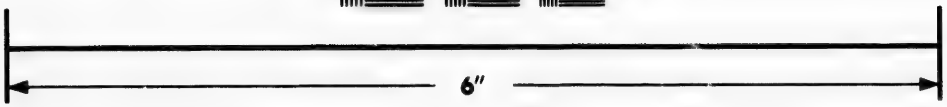

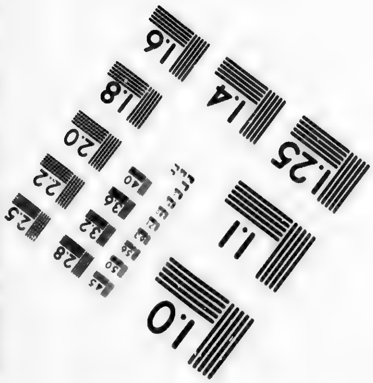

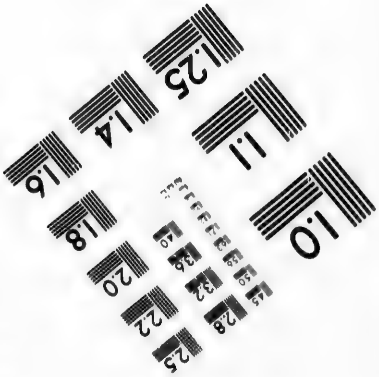

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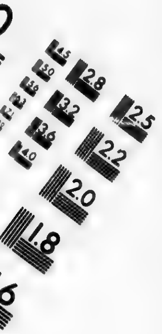
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following from extensive breeders of Holsteins—(Messrs. Smith & Powells):—"Pedigree is of little value unless it traces to animals of superior merit and breeding, and the only true evidence of superior merit is actual performance."

Pedigree is the *record of ancestry*. Breeding precedes the practice of recording animals. It first happens that by isolation and some skill in breeding, distinct breeds become established. It is then seen that by the registration of all the animals of the breed, the purity of blood would be better maintained and the value of the animals be enhanced. At this point some individual, or an association, undertake to open a register. A reasonable time is then given to allow registration of all animals whose characteristics prove them to belong to the breed. The register is now closed to original stock, and a **Herd-Book** is established.

The only condition of registration while the herd-book is being established, is the apparent possession of characteristics of the breed, and the supposed power, by virtue of purity of blood, to transmit individual and breed characteristics to offspring.

The herd-book is now open to the offspring of animals already registered, and closed to all other.

While the very existence of the herd-book is an evidence of supposed merit, it is yet true that not all the animals which obtain registration will be superior. It follows that the mere fact of pedigree, at first and later, is not absolute proof of individual or even of family merit. The real value of pedigree is that it is a presumption of merit—of the possession of valuable breed characteristics, and that it affords an opportunity for greater assurance by tracing the record back to the original, for *proofs* of merit.

Only a small percentage of the stock of the country is pedigreed. The main portion is outside of the herd-books. Necessarily, none of this stock is eligible to any of the existing herd-books. Among these outside animals are a great number which possess marked merit as individuals, and some of them are possessed of prepotency (or power to influence the character of the offspring).

There are hundreds of these animals, perhaps whole herds, to the value of which a pedigree would add greatly. It would also be an incentive to owners to give greater attention to improved breeding.

Now while these animals are necessarily and justly excluded from the privileges of established herd-books, they need not be excluded from the *advantages of a pedigree*.

In what way may superior "common" herds obtain such advantages? Through the means similar to what had to be adopted for the different breeds, that were once in a like position—having merit without record. The means adopted was the *establishment of a herd-book*, in which registration was possible. In fact, to give all worthy animals the advantage of pedigree, it is necessary for *each owner of a herd* of such to *register his own cattle*.

This one may do in what we may call **A Farm Herd-Book**. The requirements to the successful establishment of a farm herd-book are not difficult. The first requirement is a **Record Book**—which will be the herd-book.

This book mav be on an exceedingly simple plan of arrangement, and the filling in of the record a matter of easy book-keeping. The record should be full, clear and easily understood. It should be made promptly as the facts occur. This will ensure greater reliability, and make the work easier.

The second thing to be done is to **Name the Herd**. The name of the herd should be one that cannot be mistaken for some other. It should have a perfect proprietary character, like that of a trade-mark. One way that this may be done is to couple the owner's name with the name of his locality or his home. For instance, the Ik Marvel-Edgewood herd, the Goodhue-Sunnyside herd, &c., &c. Sometimes the name alone of an individual would be so well known in a country that it would be sufficient. For instance, the E. B. Eddy herd.

The next thing necessary is to **Individualize Each Animal** in one's herd—to give each animal **A Name and a Number**. These names may be according to the fancy of the owner; but they should be pleasing to the ear and easy to remember. They may be something characteristic of the animal as "Jumbo," "Petite;" or commonplace, as "Brindle," "Daisy;" or dignified, as "Katherine," "Rosamond;" or a shorter, pet name, as "Kate," "Rose."

The number of each animal would simply be the number falling to it, in *consecutive order* as its name is entered on the *List* in the *Herd-Book*.

The cheaper way to obtain a blank Record Book would be to buy one, if one could be had for purchase. If not several friends might join to have a few printed. As a last resort, a person may rule one for himself.

The next requirement is one that if not absolutely necessary, is extremely desirable. It is a **Uniformity of System** for all the herds. This is necessary for several reasons. It would make the past record of an animal available in the event of its sale and its *removal into a new herd*. It would make possible a *comparison of merits*, between animals in different herds. It would popularize the system, and make the records more easily understood.

This necessity makes it desirable that a **Standard Form of Record** be adopted. The writer with a view to help to arrive at such a result has devised a system for **Registration of Home Herds**, which he hopes will form a basis for a future standard; or which at least will record such facts as will be available for transferrence when a satisfactory standard shall have been found.

Believing strongly in the practical value of a **System of Home Registration**, and wishing to favor progress rather than possibly hinder it, this new System of Registration will not be copyrighted, but is hereby made public property. An effort will be made, however, to secure its publication by some firm, in which case it will be advertised in the APPENDIX.

The writer hopes not to create an impression that the formation of this **Herd-Book of the Farm** will add immediately to the intrinsic value of the herd. Nothing of that kind was accomplished in the cases of the improved breeds. No herd-book can give value to animals by mere virtue of pedigree. But the merit that exists and that may be developed may be better realized in values by the possession of a reliable pedigree.

Neither will all herd-books have an equal value as herd-books. Pedigrees in different books will have a value which will depend in part upon various factors—the character of the breeder, the merit of the animals, the reliability and completeness of the record, etc., etc.

The proposition to establish *Farm Herd-Books* is no disparagement to the *Herd-Books of the Breeds.* On the contrary, it is paying the latter the compliment of imitation. Doubtless even breeders of registered stock would do well to adopt the *system of home registration.* They would thus secure to themselves a better appreciation of the merit of their individual herds, and a better reward for their individual efforts. The difference between some of the herds among the breeds and some of the herds among the mixed herds outside of the magic lines, is not greater than the difference *between different herds of the same breed!* A skilful and painstaking breeder of pure stock by keeping a farm herd-book will be enabled to give a distinct value to animals carrying a number in his own book.

Some Special Advantages in the System advocated may lead many to adopt it:—

First. No one could be excluded from the benefits of such herd-books.

Second. The character of the book and the value to be attached to the pedigree of one's own herd is *wholly under one's own control.* Abuses in other herd-books need not seriously affect one's own, after a reputation has been established.

Third. Cheapness of the system. No fees. No cost for registration.

Fourth. Possible fulness and reliability of the record. If will be convenient to record, *as it occurs,* everything that will be of value as data for the future. The register being at one's hand, there *need be no delay in registration* ; errors and omissions will be fewer in consequence. Where the books show a complete and continuous record, they will have a character of reliability similar to the day-book of the merchant, which is accepted in courts of law as proof.

Fifth. An incentive to improvement of stock and better realization of profit from such improvement.

There are other advantages common to all herd-books, as, for instance, the fact that the *value of the record will increase year by year.*

All herd-books have some disadvantages. Says Miles: "Animals that have been the means of establishing the reputation of the breed by their superior merit, will be found on the record, side by side, not only with the inferior members of the breed, but with those of questionable purity of blood. Many animals may trace their descent from herds that have been noted for producing the best representatives of the breed, while others will have nothing in their ancestral history to recommend them, aside from their supposed purity of blood." Miles further concludes that the "inherited peculiarities of an individnal, aside from the general character belonging to the breed, must be determined by evidence not contained in the herd-books."

The farm herd-books will *not secure purity of blood to its pedigrees;* but constant selection and weeding out may present a *record of performance* that will form an excellent basis for estimate of value.

Performance is the real basis of all values. There would be little value in a farm herd-book that did not record the actual performance of the animals. But a record of actual performance would itself be of great value to every herd, even with no herd-book.

The most important part of performance is **Milk Value.** By milk value is meant the *quantity of milk;* and the *butter or cheese value* of that milk.

The **Quantity of Milk** is obtained by keeping a **Record of Milk Yield.** Milk may be *weighed, or measured.* Weighing is perhaps the most correct, and, with proper facilities, ought to be an easy and not expensive method. Whether by weight or by measure the result should be expressed by pounds instead of by quarts. Pounds have a universal meaning, while quarts vary in different countries. It is not necessary to record *ounces.* Anything less than eight ounces may be dropped altogether. A quantity from nine to fifteen ounces may be entered as one pound. This will make a general average of sufficient accuracy.

For convenience' sake, in weighing milk, first see that *all the milking pails are of the same weight.* A tinsmith can easily even up the light-weights by the use of a little extra solder and tin, on the outside bottom. Next, provide a weight that will exactly balance that of a single milking-pail. This "balance-weight" can be easily made at home, out of waste lead. Now, by the use of the balance-weight, the *reading of the scales* will be the *actual weight of the milk.* Thus all need of calculation—subtraction—is avoided, labor saved, and greater accuracy assured.

Where the facilities for weighing do not allow of the use of a balance-weight, there is another plan. Let all the milking-pails be of exactly the same weight. Record the gross weights at milking, that is, as though there were no pail. When adding up the totals of the milkings, say at the end of each month, or of a season, deduct from the totals for *each cow,* the *weight of the pail multiplied by the number of milkings.* For instance, suppose the weight of all the pails to be exactly four pounds each, and the total of 250 days' milkings of one cow to be 9,500 lbs. Having milked the cows twice daily, the cow would have been milked (250 × 2) 500 times, and the pail weighed that number of times. The amount to be deducted for tare of pail would be the weight of the pail multiplied by the total number of milkings, or (4 × 500 =) 2,000 lbs. The actual weight of milk, then, would be the amount of the total weighings, less the tare of pail, or (9500—2000 =) 7500 lbs.

The **Plan of Measuring Milk** has some advantages. It is cheap, and might be an accurate method. It would seem to require, however, a conveniently *guaged* vessel, that would give the measure—not in quarts, but in pounds.

As to *frequency* of recording milk-yields, **One Day in Seven** will do. An estimate based upon an actual record every seventh day will not vary enough from a full record to make it necessary in ordinary farm practice to make a daily record.

(This statement is supported by careful statistical estimates, based upon actual daily records, in the case of two cows subjected to more than ordinary causes of variation. These statistics show that the highest variation from the exact yield will occur in the case of some one cow for some single season. This variation will range from less than one per cent. to less than two per cent. The variation will always be less in a *general average*. In the estimate of the yield of the whole herd, the variation from the actual yield will be reduced to so small a minimum that the record will be practically exact. In the estimate of yield of a single cow, the variation for the whole milking-period of her life will not be worth taking into account; but some slight allowance may be made, in the estimate for a single season, for a possible variation of one to two per cent.)

This **One-Day-in-Week System** of record demands several conditions :—

First. It matters not on which day during the week—from Monday to Saturday—the milk be registered, but *there should be a certain* **Record Day**, and it should fall always on the *same day of the week*, to secure an *even interval between*.

Second. The record must *include all milkings* on that day—morning and night (or noon.)

Third. The *hours of milking* on each of the different days of the week should be *practically the same;* this will make "record day" a fair average of the other days of the period.

Fourth. The *whole day's yield* of record day must be *multiplied by seven.* The result will be the estimated aggregate yield of the period.

Fifth. When a cow, owing to sickness or other special cause, shows a sudden or unusual falling off, a full record of her *actual yield* should be kept until she returns to her normal yield.

The following is a very simple FORM of **Milk-Register** :—

NUMBER OF DAYS.	....		*No*		....		*No*	
	Calved				*Calved*			
	Mng.	Evg.	Total.	REMARKS.	Mng.	Evg.	Total.	REMARKS.
Partial Periods { 3 days	29	30	59	3 days.....177 lbs.				........days .... lbs.
6 "	1	1	2	6 days..... 12 lbs.				........days .... lbs.
7	30	31	61					
14	31	32	63					
21	31	32	63					
*..								
..	293	332	625					
..								
196	4	4	8					
203	2	3	5					
210								
Totals of Full Periods...	391	434	825					
× 7 =	......	......	5775					
+ Partial Periods.	9 days	......	189					
Full Totals..			5964					
Weight of Pails.			1696					
Net Weight.			4268	No. of days milking, 21				

* The "Number of Days" in this first column is extended, *by sevens*, to the limit desired, as follows :—7, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98, 105, 112, 119, 126, 133, 140, 147, 154, 161, 168, 175, 182, 189, 196, 203, 210, 217, 224, 231, 238, 245, 252, 259, 266, 273, 280, 287, 294, 301, 308, 315, etc.

The above form, if carefully studied, will almost explain itself. When a cow calves on the first day after record day, there will be a *full period* on the following record day. If she calves on any other day, the first period will be a broken or "Partial" one. Besides this partial period occurring immediately after milking, there may be one, also when drying off. Now, the two top lines across are ruled off for these partial periods. The first full period is entered opposite the figure "7"; the second period opposite "14," and so on. After the record will have been made, therefore, these figures will indicate the *number of days the cow has been milking;* and the figures opposite, in the columns "Morning," "Evening," and "Total," will be the *weight of milk (and pail) on record day*, or in one day in seven.

After the cow has been dried off, the record is closed. Add up the third or "total" column and place the amount under the first foot-line, opposite "Totals of Full Periods." Multiply this total by *seven* and set the product immediately under the amount multiplied. Bring down the *full quantity* yielded in the "Partial Periods," and set beneath it the product of the multiplication by seven just referred to. Add the two last mentioned amounts, and set in the next space, as a "Full Total." Now deduct the weight of milking pail, multiplied by the whole number of milkings, and the balance will be the *full yield* for the *whole period of milking*.

The "Number of Days" of the milking period is found by adding the *number included in Partial Periods* to the *number opposite the last record of a Full Period.* This amount may be set at the foot of the column for "Remarks," for future reference.

In the above FORM is given an imaginary record to show the system of keeping the Register. The cow was milked three days of the first period, and on "Record Day" she gave 59 lbs., or a total of (59 × 3) 177 lbs. For the "Number of Days" between "21" and "196," the record (to save space) is given in a single amount; and is 625 lbs. The last weighing was a total of 2 lbs.; this, too, was a "Broken Period" of six days, giving us (6 × 2) 12 lbs. Adding up the "Full Periods," we have a total of 825 pounds. In multiplying this amount by seven, or the Number of Days in a period, we get the total gross weight for the Full Periods; or (825 × 7) 5,775 lbs. Adding to this amount the weight for Partial Periods, we have (5775 + 189) 5964 lbs.

By adding the 9 days included in the Partial Periods to the 203 days of the Full Periods, we have the whole Number of Days, or 212. The Number of Milkings is this latter amount multiplied by 2; or, (212 × 2) 424 days.

Multiplying the weight of the milking-pails by the number of milkings, we have the amount to be deducted for tare, or weights of pails. Assuming the weight of the pail in this case to be 4 pounds, it gives us (4 × 424) 1696 lbs. of tare. This amount subtracted from the gross weight, gives us the net weight of milk; or (5964 − 1696) 4268 pounds.

There is less calculation in this than would appear from the long explanation that is necessary; and the little calculation does not necessitate a tithe of the labor involved in daily weighings, or in the daily subtractions of weight of milking pails.

The Register may be ruled for as many cows as convenient—say one to five. A single full sheet of foolscap may be ruled conveniently to register the yield of *five cows,* for a *whole season!*

The labor, therefore, of keeping a register for five cows, for a full season, involves only the weighing (or measuring) of the milk one day in seven, and the filling out of a single sheet of foolscap—on one side.

While it is not absolutely necessary, it is very desirable to keep a **Supplementary Milk Register**. Calculate, or estimate, on "Record Day," the full actual yield for the seven days. Divide this amount by seven, and the quotient will be the correct amount to place in the columns of the Milk Register for that day. The following is a convenient form of

SUPPLEMENTARY MILK REGISTER.

Date.	Mng.	Evg.	Total.	Remarks.	Date.	Mng.	Evg.	Total.	Remarks.

A Register Board is the next requisite. This is simply a planed board to carry the Register, which latter may be tacked to the board at each of the four corners. A string, nearly the length of the board itself, is fastened by one end to the top of the board, and to the other end is tied a lead-pencil, which is always kept sharpened. The board itself is provided with a hole at the top, or a string, that it may be conveniently hung upon a nail, at the stable, or in the house, and easily removed. For tacks, regular "drawing pins" are the best; failing which, take common tacks, and make up for a small head by putting on a stout leather "washer," or loose head, wider than the head proper. This is a simple and cheap apparatus, and a wonderful convenience.

A **Secondary Object of a Milk-Record.** Cows are affected by such influences as changes in food, in the weather, by their general treatment, by disappointment, by accident, sickness, &c. Some cows are more sensitive to such influences than are others. The cow least affected by these conditions, other things being equal, is the best cow. Now the milk record is a very good index of these conditions. It is well, then, to keep a record also of these influencing changes, such as temperature of the stable; changes in feed; bad treatment of the cow, like being run by dogs; periodic bodily conditions; accidents; sickness, &c.

Not only will these records show the hardiness and relative value of the cow, but they will call attention to what are the helpful, and what are hurtful influences, and so have an educational value. For instance, if a dog be set upon a cow, or if she be otherwise ill-treated, the milk record will be affected.

Let it not be supposed that these records involve great labor or much time. If some systematic plan be adopted and constantly followed, it becomes a simple matter of a few minutes each day; and it soon becomes an interesting work to the dairyman who has set himself to improve his stock.

The **Butter Value of Milk**, or its **Cheese Value**, is the *number of pounds of butter*, or *cheese*, in each *hundred pounds of milk*. To obtain these values for practical purposes, it is best to adopt the usual process of the dairy.

For butter value, several milkings of the cow to be tested are kept separate from the rest of the milk, *carefully weighed*, and the whole set by itself, either in deep cans or shallow pans. It is in usual order skimmed and ripened, then churned at one churning.

To secure correct results, a **Rule of Process** should be adopted and always followed. The following is suggested: Skim at 36 hours. Stir Cream thoroughly as each new lot is added. Let the cream stand for 12 hours after last mixing, at a temperature of 60°. Churn at a temperature not above 60°, except when the cream is difficult to churn, as in winter when affected by distance from calving, dry feed, &c. Brine-salt the butter.

The Rule for obtaining butter value: *multiply the weight of the butter by 100, and divide the product by the weight of the milk which produced the butter.* Example—Given four milkings, which weigh as follows: $16\frac{5}{16}+15\frac{12}{16}+16\frac{4}{16}+15\frac{9}{16}=63\frac{14}{16}$. This milk produces $2\frac{10}{16}$ lbs. butter. To make the calculation easy, reduce these amounts to fractions; which, of course, will be ounces. Milk, $63\frac{14}{16}$ lbs.—1022 ounces; butter, $2\frac{10}{16}$ lbs. $=42$ ounces. According to the above rule, "multiply the weight of butter (42) by 100": $42\times100=4200$. "Divide the product (4200) by the weight of milk which produced the the butter (1022)": $4200+1022=4.15$. The answer: The butter value of the milk of the cow tested is *4.15 lbs. butter for every 100 lbs. milk.* In other words, the butter value is *4.15%* (four and fifteen hundredths per cent.).

In estimating milk *quantity* the ounces were not taken into account because they were averaged. But in weighing milk for test of *butter value*, it is necessary to be as exact as possible. The large proportion of milk to butter, about 25 to 1, introduces an element of error. An error on either side is really multiplied by 25. It is necessary to be exact to the ounce in these tests, after which we may trust to beneficent working of the law of averages.

In testing for butter, or cheese, values, it is not necessary to use a specified number of milkings, nor to adopt just the process above described; but it is necessary to *treat all cows alike*, and always to carry out as nearly as possible the same process in every case. **Results** should be **Carefully Recorded**, and kept for **Permanent Reference.**

Frequency of Tests for Values. Tests become of greater value the oftener they are repeated; but for practical purposes, they need to be repeated only till a certain *uniformity of result* shall have proved their *correctness* and *permanent value.*

For this reason, it will seldom be necessary to long continue making these tests. After a time, the butter value of each cow *will be established;* after which only an occasional test will be necessary, to note any variation caused by age, food, treatment, &c. It is desirable, however, when testing, that all the cows be tested in *immediate succession.*

An interval may then intervene, and the cows be tested again, preferably in the same succession and order. Intervals between tests may become longer as the tests are repeated and the results are more uniform, until they are discontinued, except an occasional test as above explained.

A Register of tests for values is necessary. The following **Form of Register** will be found convenient for **Butter.**

No. of Test.	No. of Cow	Age	Days After Milking.	Days Before Milking.	Consecutive Milkings.						Time of Last Skimming.	Quantity of Cream.	When Churned.	Temperature.	Time Churning.	Butter		Butter Value.
					Date of First.	1	2	3	4	Total.						Fresh.	Salted.	

Since all comparative tests should be made as nearly as possible in the same manner, certain **Conditions of Tests** should be adopted. The following is suggested as an example for testing for butter values. Include *four milkings;* allow milk to stand *not over* 10 minutes before setting; employ deep-setting system, 36 hours; ripen 12 hours, at temperature of about

60°; salt medium, or brine-salt. Note temperature of churning, and try to churn at same temperature till the test has been applied to all the cows being tested. If it be necessary to change the churning temperature, let it be done when beginning the round anew.

The foregoing method of testing applies to farms of ordinary equipment. To carry it out no extra apparatus is required, except several milk-cans large enough to hold a single milking, a small sized cream-holder, a churn smaller than the one in ordinary use, the **Register** and **Register Board**, and light scales or balances. In other words, all that is required is to weigh and set the milk, churn it, weigh the butter, and keep a full register of the facts. This may be accomplished, on many farms, with no extra outlay at all. In any case, the outlay need not be large.

For milk cans, or "creamers," what is wanted is a tin pail with glass and faucet at bottom, and a cover that is ventilated, similar to what has been illustrated in the section devoted to "Creaming."

For size, one 20 inches deep by 8 in diameter will hold a little over 35 lbs. (3½ gals.); and one 20 inches deep by 6 inches in diameter will hold a little over 20 lbs. (2 gals.)

Either creamer can be used with lesser quantities. They can be made by the local tinsmith. Where even so small expense is not practicable, the work can be done by the shallow pans, and the churn, in ordinary use in the dairy, although not with the same degree of convenience and satisfaction; if scales are not available, the milk, with care, may be measured and converted into pounds. At ordinary temperatures, or about 60°, an imperial gallon of milk will weigh approximately 10¼ lbs., and a wine gallon will weigh 8¼ lbs. This will be sufficiently correct for purposes of test.

IMPROVEMENT of Stock. One object of the dairyman should be to make as much good butter, or cheese, as he can per acre. To succeed in this aim he will require that his cows be good ones. **Selection**, will be the first means to be adopted to improve the herd. The cow is not everything. The best cow will do her best only when well-kept—well-treated and well-fed. But some cows are so poor that no skill in keeping them will make them profitable to the owner.

It is probable there are some of these cows in most of the ordinary herds. It is probable that in most herds not only there are cows that do not give any profit, but some that are kept at an *actual loss*. A dairy writer, in 1851, gives the result of a number of experiments made to test the butter-value of the milk from twenty different cows. The result showed that the number of pounds of butter to each hundred pounds of milk ranged from so low as 2½ lbs. to as high as 6⅛ lbs.

The average of this whole herd was a high one for an ordinary herd—being 4⅛ lbs. Six cows gave about the average. The average of seven was 3 1/6 lbs., or over 25 per cent. *less* than the whole average. The average of another seven was 5⅛ lbs., or over 25 per cent. more than the whole average. In other words, the seven best cows gave *nearly 80 per cent.* more than the seven poorest! Unless there were an extraordinary profit in the herd, or the seven poorest cows were very small consumers, it must follow that one-third of the herd were kept at a loss. At all events, the large excess over the average that one-third of the herd gave, went to *make up the deficiency* in the quantity given by the same number of the *poorest cows.*

It is to be feared that even now, over a quarter of a century later, there is little improvement. Hon. Harris Lewis, a keen observer, and one of the best authorities in practical lines, in 1882, claimed the existence of a similar state of things in the old banner cheese county, Herkimer, N.Y. He said that one-third of the cows there failed to pay their keeping; about one-third will balance the books, and from one-third they reclaim a profit. That is, one-third of the cows, pay for the loss sustained on the other third, and leave a little margin of profit."

By selection is meant the weeding out of poor animals, and replacing them with better ones. It does not necessarily mean selling off half the herd, and the immediate purchase of cows to replace that half. Although this might in many cases be a profitable transaction; it is not generally practicable. But selection does mean the getting rid of the poorest cows of the herd as fast as circumstances will allow, and the filling up of the herd with good cows, or what give every promise of making such cows. And this is easily done. It is a gradual process that involves intelligent discrimination and judgment, notwithstanding a full purse.

The first requirement in selection, is to *learn the value of each cow in the herd.* This will be done by TESTING. In the instance quoted, of 20 cows, the owner knew, by the general result, that his cows gave an average of 43⅛ lbs. Only by actual test could he know that one cow gave over 6 pounds while another gave only 2¼ lbs!

A knowledge of the real value of all the cows in the herd, singly and relatively, is easily followed by a weeding out of the poorest, and the gradual improvement of the whole herd.

One should not be satisfied with the low average yield of existing herds. There is reason to believe that the average is not over 100 lbs. butter a year, per cow. The writer has in mind one dairy in which are made 3200 pounds with 30 cows. This dairy is doubtless above the average of most dairies, in most districts; for in the dairy herd are cows which have been tested for butter and have yielded two pounds in one day. There are not many ordinary dairies in the country in which are cows which will give two pounds in a single day; and the dairymen are few who have ever taken the little trouble necessary to learn how much butter their best cows may give.

Grades. The most the average farmer can do in the way of introducing pure blood into his herd is by means of crossing.

Mr. Arnold says that crosses between thorough-breds are frequently improvements upon the original stock. We are told of a dairy owned by Mr. Fish (in which was produced 800 lbs. cheese to each cow) that was made up of grades and crosses, most of them crosses between Ayrshires and a milking-strain of Shorthorns.

The early general improvement of the herds of the country must needs come through crossing. Thoroughbred stock were estimated by Mr. Arnold, in 1874, to be only about one per cent. of the dairy stock of the United States. Only a part of these were enough better than common stock to be worth buying at an enhanced price. Even this inferior stock is not within the reach of the average dairyman, to make up a full dairy, even if it were well that it should be. Happily the improved breeds are available (in the use of males only) for the infusion of fresh blood and the supply of grades. In this way it is open to every dairyman to secure the very best blood, and at a cost within his means.

Doubtless, the reader will not need to be told that continued improvement demands that the males be always pure, and never selected from grades.

Relative Value. For determining the relative value of different breeds, it can hardly be said that we have sufficient data. For the practical purpose of milk-production, the important question is: What is the relative actual yield of the various breeds? We have many records of the actual yields of individual cows, and even of herds; but the data is inadequate for the needs of just comparison. We do not always know the full conditions under which the yield has been obtained, or what was the food, its cost, etc. Even if we knew this in some instances, we do not know it in the cases with which we would desire to make a comparison.

It is very probable that the day is fast approaching when the real test of value—performance—will be recognized by breeders, and our questioning be anticipated by such careful and complete tests as will be quite satisfactory. Ere long it is likely that we shall know the yield, and the *food cost* of the yield, of a sufficient number of cows and even of herds, to make choice comparatively easy.

In the meantime, we know that each breed has some special merit that adapts it better than any other breed to certain circumstances. We know enough of the general characteristics of the different breeds to enable us to make a fair choice to suit our peculiar needs. We know too, that in all the breeds there is a great range of merit, running from high perfection almost or quite to the point of scrub level.

The characteristics of the different breeds are so marked that they naturally divide up into special lines of production; as, for instance, milk or cheese breeds, butter breeds, or beefing breeds.

Breeding is the next means of securing a better herd. Space will not allow adding much to what has already been said on this subject.

Rules in Breeding. 1. Do not couple extremely large males with very small cows. The tendency of the large male to beget his like in a large offspring is likely to overtask the capacity of the female to carry, nourish, and easily deliver the offspring. The result is frequently injury to the cow, and usually unfavorable to the good form of the calf. If it sometimes happens that no bad results arise from such a course, it is doubtless because the male is less prepotent in size than in some other characteristics.

If it be desirable to cross animals of a large-sized breed, like Short-horns, for instance, on small cows, choice should be made of the smaller-sized males of the breed.

There is not the same objection to coupling small males with large females; on the contrary, the result is sometimes very satisfactory.

2. Avoid unnecessary crossings. Persist, for the sake of prepotency, in coupling certain animals as long as results will warrant so doing. Here it is wise to let well-enough alone. Change may become necessary under conditions like the following. (1) When bad results are apparent in coupling certain animals; when the results are possibly good, but inadequate, and something more promising offers; when animals are getting too old; when animals are too close of kin, and constitutional defects are apparent or feared. Change should not be made without such or similar reason therefor—it should never be made for the mere sake of change, which is *in itself undesirable*, because of the natural law of prepotency. As Allen has well said:— "It is mischevously introducing a multiplicity of crosses into one's herd, and thus scattering their blood into uncertainties, and wide variety of offspring, when *fixed* excellencies might be perpetuated to more advantage."

3. Have a due regrad for *pedigree*. By pedigree in breeds is meant an authoritative record of ancestry. Pedigree has not a direct intrinsic value, like *blood*. It is to blood what a promise to pay is to money. It is a supposed guarantee of blood. It is the ancestry that has the intrinsic value, and the pedigree has merely a representative value. As such it is important. The animal which has a good ancestral record may be expected, to show a good individual record, and he should be valued accordingly.

But the mere fact that an animal has a pedigree is not enough. Such an animal is presumably a better than ordinary one, because he is pure-bred. A promise to pay is better than no promise. But as one would not highly value a note of hand without knowing *how much* is promised, and what the character of its endorsation, so we should not really value pedigree without knowing the character of the pedigree, or whether it is reliable, and what it shows the ancestors to have done.

Even at the best, to have a due regard for the pedigree is to give it a place, as a rule, subordinate to the *individual record*, or appearance, of the animal in question. Both tests should be considered, but mainly that of the animal itself.

Selection. Certain Points which “all cattle, of any breed, should possess :—

“1. A fine head, small and lean.

“2. A broad, full and deep chest, giving room for well-developed and vigorous lungs to play.

“3. Good length, breadth and roundness of body, roomy and full from shoulder to hip, with low flanks, thus giving room for abundant action of the viscera, or bowels; and expansion for the foetus, if in a female.

“4. Straight back, broad hips and good length of loin.

“5. Fineness of bone, and smoothness in the carcase generally.” (Allen.)

Rules for Cow-House. “A breeding, and milch cow, should always be gently and kindly treated.

“She should never be driven at a pace beyond a walk.

“She should never be jumped over fences or bars, and when necessary to pass them, they should be let down low for her to go through easily, and without effort.

“She should not be boisterously shouted at in driving; and if where a number are together, they at any time become crowded, ample time should be given to get out of each other's way without hooking, or hunching.

“Never suffer the cow or the herd to be worried by dogs, either by driving, or in the field when grazing.” (Allen.)

The cow's health, her dairy qualities, and her future care, are values which demand gentle treatment always, and were it not so the instincts of manhood must condemn brutal treatment at any time.

Pasture. The perfection of feeding is pasture-feeding at its best. Summer weather; rich upland slopes; sweet grasses unmixed with weeds, for food; water pure and abundant; fields, roomy; shade, convenient; quietness, comfort and plenty:—all the essentials of health and comfort are here—air, exercise, food, drink, in perfect combination. No wonder it was used by the Psalmist of old as a figure to express human happiness.

Such is pasture-feeding *at its best*. The reality in practical life too seldom approaches it. Too often it is at its worst. Scant, weedy, innutritious grass, giving in a day's travel all over it too little food to produce milk without robbing flesh; water out of easy reach and at that sometimes stagnant; no pleasant shade without long tramping after it; flies all day; dogs for drivers, and kicks from milkers—Poor brutes! All of them! Such is the pasture at its worst.

It will be the general practice, and doubtless the most profitable, to make pasture of the land that is most difficult of tillage. Such land is sometimes admirably adapted to pasture and not at all so to tillage. For instance, rolling ground, broken by a stream of water, rocks and clusters of trees, etc., often possesses large space of ground that will produce finest herbage.

All pasture has similar requirements in the matter of *warmth*, *moisture*, and *plant-food* and *roots or seed* for its grass crop.

In old natural pastures the grass is frequently found too thin. Manure will cause it to thicken, but sometimes **Seed** must be sown. Preparation for seed may be made by a fine-tooth harrow, and sowing may be followed by an application of fine manure or bone.

Better still, is the thorough **Cultivation** and sowing with a variety of succulent grasses with a view to its being *permanently* productive. It is a poor pasture indeed that is to be used for years, that will not pay for such thorough cultivation and preparation.

When the pasture land is cold from excessive dampness, resort must be had to DRAINAGE.

In natural pasture, dampness is perhaps less frequent than **Dryness**. When there is not enough moisture to prevent drying up of grass, the latter may be protected by a mulch. A suitable mulch will be found in manure, muck, straw, bog-grass, or any light brush. This mulch will also add more or less fertility to the soil, which is required.

Succulent Food. It is doubtless true that nature is best served by a food in which the water and dry matter are well mixed chemically. The ideal food would be the tender, juicy grass. Succulent food must not have in it water to an excess. Green soiling-crops have this defect. They have too much water. Moreover, such crops are too green and immature. Just what difference there is between a very green apple and a ripe apple, chemistry does not indicate, but the difference exists. There is a similar difference between quick-grown, watery plants, like corn, when very green and when riper. Hence, before feeding out these plants they should be allowed to lie a day or two after cutting, to wilt. They will unburden surplus moisture, become concentrated, and approach that ripened state that will make them more wholesome for cattle.

Cattle thrive, of course, upon the green pasture grasses, fresh grazed, but it does not follow that they should thrive upon the larger, ranker, coarse plant fodders, like corn.

Soiling. It is difficult to define the term *soiling*. It has been defined by one as artificial feeding when the pastures fail, and by another as the act of feeding cattle green fodder. Neither of these definitions cover the actual use of the term. It does not refer exclusively to either of the above. A definition that better accords with the recognized use of the word is that it is the artificial method of feeding cattle in the pasturing season in place of the natural method of grazing them. It applies mainly to the grazing season.

There are practically two distinct methods of soiling. One may be termed *Part Soiling* which is partial feeding and partial grazing. The other is *Full Soiling*, which means the entire substitution of feeding, for grazing or stable for pasture.

There are many reasons for advocating part soiling rather than urging full soiling. Part soiling combines the advantages of both pasturing and soiling. It also is a change more practicable, more easily carried out, and more *likely* to be carried out. It is a first step in the way of progress, and whatever good there is in the last step will be better appreciated after knowing by experience the advantages of the first.

Part soiling, which is a supplement to the pasture, and not a substitute, is to be strongly recommended. There is everything in favor of the practice, and not one reason to urge against it.

There can be little question of the advantages of half-soiling, because it combines the best advantages of pasture and feeding. The advantages of full-soiling are a question of price of land and labor, and state of land.

Some of the advantages of half-soiling are :—

1. Obtaining full value of pasture. If land in the flush of season is not nearly full pastured, the grass will grow rank and be unsuitable for feed. If it be full pastured, the result is more serious, for during the dryest season the cattle will not be sufficiently fed. They lose milk and perhaps flesh, and do not recover the milk. Soiling will allow the full use of pasture, and will supplement the lack when there is dearth.

2. Cattle will give more milk by semi-soiling. It is almost impossible in most climates, when utilizing pasture to the extent that farmers practically will do, to keep up the milk flow. And some years there comes an unusual drought. By soiling, the cattle may be full-fed, because the lack of pasture is fully supplemented.

3. More cattle may be kept on a given acreage by reserving an acre or two to grow soiling fodder, and by putting on pasture all the stock it will feed during the flush season ; the fodder will supplement the lack when pastures fail, and thus more cattle can be kept on a given acreage.

4. Pasture may be kept in better condition. The feeding of cattle in pasture from other food than that produced by the pasture itself, enriches the pasture. Again, part soiling prevents sometimes injury to pasture. When during summer drought or fall dearth, the cattle feed so closely as to injure the crop of the following year. Soiling at such time avoids this disaster.

An easy method of part-soiling is to sow a piece of ground with corn, to be cut when green, and fed to cows as the natural pasture-supply falls off. More than is likely to be required should be grown, the balance being most useful to bridge the change from pasture grass to stable hay. Grain, even, may be profitably fed along with this green fodder, especially if the latter is insufficient in quantity. The manner of feeding the extra food in pasture is of some moment. The practice of feeding it at one particular spot may do well for convenience; but it results in making one part of the pasture very rich and leaving other parts very poor. If it were carted to a part of the field where it is most needed, the presence at that part would enrich it. If not convenient to cart the fodder, the solid manure occasionally might be gathered up and spread over other parts of the field more in need of it.

Corn. In dairy-farming corn is in the way of playing almost as important a part as meadow grass. A knowledge of its cultivation is important.

Corn must be planted, in northern limits, in the warmest location and soil; and, anywhere, the soil needs to be mellow, rich and clean.

Corn is so rapid a grower that it requires a soil rich in plant-food that will readily respond to its demands. The plants may be well started by sowing with the seed some quick-acting fertilizer.

Do not plant till the ground is warm. A rule given by some authority is to plant when the thermometer averages 60 degrees in the shade.

There are two common ways of planting corn in drills and in hills. "Planting in drills gives more plants, and so, a greater yield to the acre, and is best on clean land ; hill-planting allows the crop to be worked both ways, and is preferable on weedy soils." (*Am. Agriculturist.*)

"The chief enemies to sprouting corn are various cut-worms and grubs below ground, and crows and black-birds after it is up. Tarring the seeds will keep off insects. A pint of warm tar and a peck of seed are stirred together, until every kernel is evenly coated, then roll in plaster. Birds are kept off by scare-crows (pieces of tin from hanging cords) clattering wind-mills, &c. (*American Agriculturist.*).

Corn Fodder. This is good feed ; easily grown, and yield per acre is large. It must, however, be properly cured and stored. If left in the field and long exposed to weather, alternate rain and sun, it loses its value as food, and is not worth the labor expended upon it.

Wheat Straw is not very nutritious, but where fodder is scant it may be used in small quantity. It is well to stack it, and allow cattle access to it when they are out for exercise and air.

Roots. "Fed out from a cellar, where the temperature is near freezing, are too cold upon the cows' stomachs. May be obviated by mixing the cut roots with a little corn-meal and some cut hay which have been moistened with hot water." (*American Agriculturist.*)

Potatoes. Either raw or cooked, make good feed. Are improved by being mixed with bran or meal.

Pumpkins. A good fall and winter feed to add to main feed.

Ensilage is green fodder preserved in a fresh state. The manner of preservation is similar to that used in canning vegetables, and fruits for human food—by exclusion of air.

A Silo is a receptacle constructed purposely for holding and preserving green fodder. *Ensilo* is the verb used to express the making of ensilage. The word ensilage is also used as a verb in the same sense: We put corn fodder in a silo, and ensilo or ensilage it, and the product we call ensilage. The main requisite of a silo, is that its walls be air-tight, and that they be perpendicular and smooth to facilitate the weighting and settling of the fodder. The silo may be built with any convenient material stone, wood, brick, concrete; its walls even may be earth. It may be constructed and located in any manner desirable, above or below ground.

The fodder is usually cut small and closely packed in the silo and well treaded down. It is covered by boards or planks upon which heavy weights are placed, the whole cover following the fodder as it settles. The weights are stones, logs, or boxes filled with earth.

The less the change in the fodder the better the ensilage will be. In practice, ensilage is generally found to possess an alcoholic or acetic odor. This indicates a loss of nutrition and a less wholesome food. Some instances of fodder remaining almost or quite unchanged, point to the possibility of making it practicable to always produce such a result.

Animals soon become accustomed to ensilage and, it is claimed, thrive under it.

Ensilage should be given at first in small quantities, gradually increasing.

The question of the value of ensilage is not yet definitely settled. The weight of experience, however, seems to be in its favor. Whatever may be urged against it, there are not a few positive advantages in its use which cannot be questioned.

Any who are inclined to give it a trial, are advised to read up the now plentiful literature upon the subject, *and to visit the nearest neighbor who has built a silo.*

Cotton-Seed Meal. The value of this food is double. It may be worth its cost as a food —to cause increase of the milk. But its manurial value is also great—exceeding that of any of the ordinary grains.

It is a highly concentrated food and must be fed with great care. Always feed carefully at first. Feed it sparingly both to pregnant and newly calved animals. It has a tendency when fed in quantities, in the one case, to produce abortion: in the other case, garget.

Changes in Diet are made at a cost of food or waste. They are cause of loss in proportion as they are sudden. Let them be made as seldom as possible, and let them be *gradual.*

The intelligent proprietors of mountain farms in portions of Europe begin the pasture season by letting the cows out towards night when the cattle are not hungry, and even then only for an hour at first, increasing the length of time, little by little, every day. The result has been an increase rather than a decrease in milk-production.

The change from a rich diet to a lighter one, doubtless, produces less disturbance than *vice versa.*

Table of Equivalents; on the **Basis of Hay.** (Approximate). To 10 bs. of Hay, @ $10 per ton, the following are equal :—

		Per Ton.
40 to 50 lbs.	Green Clover.....	@ $2.00 to $2.50
8 » 10 »	Clover Hay......	10.00 » 12.50
25 » 30 »	Green Indian Corn	3.25 » 4.00
40 »	Dried Corn Stalks.	2.50
33 » 50 »	Wheat Straw	2.00 » 3.00
17 » 40 »	Barley Straw	2.50 » 6.00
10 » 16 »	Pea Straw.......	6.00 » 10.00
20 »	Buckwheat	5.00
		Per Bush.
4½ to 6 lbs.	Wheat............	@ 50c. to 67
5 » 6 »	Barley...........	40 » 48
4 » 7 »	Oats.............	25 » 42
5 » 6 »	Indian Corn	47 » 56
3 » 5 »	Peas or Beans....	60 » $1.00
6 » 7 »	Buckwheat	43 » 50

		Per Bush.
20 to 40 lbs.	Potatoes	@ 7½c. to 15
34 » 36 »	Mangel-Wurzel .	8½ » 8½
50 »	Turnips.........	6
45 »	White Carrots...	6½
25 » 30 »	Red Carrots.....	10 » 12
20 » 30 »	Cabbages.......	16 » 25
		Per Lb.
5 to 7 lbs.	Linseed.........	@ ½c. to 1
2 » 4 »	Oil Cake.........	1½ » 2½
		Per 100 Lbs.
10 to 12 lbs.	Wheat Bran.....	@ 40c. to 50
10 »	Rye Bran........	40
16 » 18 »	Wheat Chaff	28 » 31
17 » 18 »	Rye or Barley....	29 » 31

Rye Straw, same as Green Clover; Oat Straw, same as Barley Straw; Rye, same as Indian Corn; Pea and Oat Chaff, same as Wheat Chaff.

Shelter. The importance of stabling animals is not fully realized. If it were, animals would never be seen shivering, even on the prairies, where an economical shelter would permit it. Granted that the animals live through the winter and appear to thrive, it remains true that more food is consumed, and that disease, sickness, loss of animals, especially among young and feeble ones, often results from an exposure that could be avoided at a profitable cost. To go to much pains and some little cost to provide good shelter for animals, to treat them humanely, is to domesticate them, to lessen cost of keeping them, and to increase their actual value, and their yield.

Salt for Cows. If cows were forced to eat salt by it being put into their food, it might do them harm, but it is extremely doubtful if cows will eat too much salt, if they are allowed free access to it, and free choice to take it or not. Salt being an apparent need for the system, will help to keep the animal healthy. This will increase the flow of milk and improve the quality. It is believed that salt will do this directly, and that its use will improve the churning quality of the milk. But salt should be given regularly. If not there will be suffering; at one time from lack of it, and at another time from excess of it. Provide rock salt, and have a place for it where the cows can always go to it. Put a trough in the yard; or a box in the side of a building (with a roof); or a box under the cattle shed.

Watering Cows—How Often. It may be regarded as a practice that cows will drink water oftener in summer than in winter. Some good farmers water once a day in winter and twice in summer. If cows are turned out for water twice a day in winter, it is enough. But if water were conveniently available, it would be better to give at least thrice daily, even in winter. In summer especially, it is better to allow stock constant access to water, in plentiful quantities.

If cows are turned out to water when weather is cold they should be put back *immediately*. If the weather is mild they will be the better for a little while of airing.

Warm or Cold. In winter, warm water is better than cold. If not supplied warm, the temperature must be raised in the body of the animal, and this heating is at the expense of food. When stable is properly ventilated, in cold weather a deal of food must be expended to keep the cows warm. It would be thus not only a saving of food to give cows warm water, but would be less of a tax upon the physical economy.

On the other hand, artificial heating of water is done at cost of fuel and time. Whether it will be a gain to heat the water will depend upon the cheapness and convenience of heating. The fuel required to heat the water would not be likely to cost so much as the fuel in the shape of feed supplied to the animal with which to warm the water. If the work of heating can be made reasonably light and convenient, the advantage would be decidedly in favor of *heating*.

Carding Cows. The skin is one of the outlets for waste matter. Life and health depend no more upon the assimilation of food for maintenance, than upon the discharge of all the waste matter in the animal economy. Abundant provision is made for the escape of all waste matter, but it is all needed. The *skin* does a large part of the work of eliminating the waste of the system. The skin is not a perfectly closed covering. It is full of pores which are nature's channels for the escape of waste, or impure matter The escape is in perspiration or sweat.

In a state of nature, the skin of animals is in a comparatively healthful condition, and performs its functions properly. The vigorous action in wild life, the air, sunshine, rain-washings and the roomy fields affording always a new and clean bed: all this conduces to the healthful condition of an animal. Its skin takes care of itself. Perspiration is perfect, and the impure matter is evaporated, rubbed off, or washed off. Not so in a state of domesticity. There is a less vigorous state of health, induced by the general habit of life, and the skin and all the organs feel it. None of the organs, internal or external, are, in this condition, so capable of properly doing their own work. Yet, if one organ be obstructed, the other organs are called upon to do more than their own part of the work. It is under such conditions—when it can least be afforded, that some of the organs are obstructed. The confinement of animals during a season of the year in closed barns, the lack of exercise, the artificial diet, the limited space, the tainted atmosphere, have the effect of reducing the vigor of the whole system, and especially in impairing the functions of that part of the system which is no less important than the other organs as an outlet for waste matter—the skin.

This condition of things in artificial life is artificially met. First, by making the condition as favorable as possible—in keeping the stall of the animal clean and well littered. Second, by cleaning the body of the animal—by an occasional washing or sponging, and a daily brushing or carding. If this be not done the skin becomes clogged, the perspiration is retained in the blood, poisoning the blood; or if the animal be a milker, making the milk impure and unhealthful, and tainting the products of the milk. Thorough brushing removes the scurf and promotes healthy action of the pores.

The most effective means of securing this desired result of a clean skin and a healthy action, is the card and brush. The use of the card is demanded at all times where animals are stabled, but it is demanded especially when they are shedding their hair. The brushing should be daily—and will repay the labor—but if the dairyman thinks that this cannot be done, let it be done less frequently—at least once a week.

It is the common practice to apply this care to horses, but it is not a common practice to apply it to cows. Why this is the case the writer cannot explain. That there is no sufficient reason for it the writer is sure. If there is a constitutional difference between the two animals and the structure of the skin that makes a clean skin and open pores necessary to the health of a horse and not to a cow, the writer has yet to learn it. It is possible that because of the larger value of the horse the owner believes the time spent upon it well paid in the one case and not in the other. It may be claimed that there are farmers with whom labor is so valuable and whose cows are so worthless, that it will not pay to card the cows, even to maintain them in health and to have the milk good and pure. If this be the case it is better either that their cows be improved, or the dairy sold off and the high-priced labor be turned into a more congenial and profitable channel. CARD THE COWS.

Exercise. There is no doubt that every animal as well as man absolutely requires exercise as a condition of good health, and thorough exercise, or exercise of different parts of the system. Animals may do comparatively well when shut up all winter in a stable, but their well-doing is owing not to lack of exercise, but to the absence of other unfavorable conditions, or to some favorable conditions in other respects. Preserve the favorable conditions otherwise, and add the exercise, and the animals would do still better. But unless exercise can be provided without the unfavorable conditions sometimes attending it, it is better to be without. For instance, to leave animals, for the sake of exercise out of doors long enough to become cold and wet and chilled, is to waste the extra feed, to resist the cold, and to cause disease as a result of such exposure. Especially is this true of cows in full milk, which require only the gentlest exercise, and are very susceptible to exposure.

During cold weather, it is economy to give cattle very little exercise. It is enough in extreme cold weather to let the cattle out at noon for a short time only, at which time they may be also watered. Accustom cattle to go back to stable, and it will be noticed how willingly they seek comfortable quarters, and how unkindly they take to the pleasure of shivering in the outside cold.

Fertilizing. In nature, nothing is produced from nothing. A blade of grass will no more grow without food than will a cow.

Plants are dependent upon the soil in which they grow for the food which they need. This food is called *plant-food*. Some soils are richer than other soils in plant-food; but all soils are alike in this, that the amount of plant-food contained is limited. Some soils may be drawn upon for years and yet retain sufficient to promote growth of plants; other soils contain a light supply and will hold out against a drain but a short time; and all soils will give out sooner or later. If the plant-food contained in the soil of earth were exhausted, the earth could yield no fruit, and the races dependent upon the fruits of the earth would be starved out.

Every tiller of the soil who, by constant cropping, drains his soil of the plant-food of which his grain and other productions are composed, is helping to bring the earth to such a state that it will fail to support human and animal life. If life is so dependent upon such plant-food as causes a blade of grass to grow, it is surely true that he is a benefactor who increases that plant-food so that two blades of grass will grow where only only one grew before; but what is he who causes none to grow where one grew before?

Man cannot create plant-food, nor can he destroy it; but he can waste it, or he can save it.

If man can prevent the untoward result of waste, he owes it to himself and to posterity to do so. And while it holds true that by the sweat of his brow man must eat bread, he must cease to waste, and labor to save, or——die!

Is it possible that there is needed, in this wonderful advanced nineteenth century, any prompting to the intelligent, humane tillers of the soil, the bone and sinew of the world, to have a due regard to their duty to themselves and the humanity of the future, whose heritage of earth and land and farm it is that they hold for their season? While nine out of ten farms are left poorer by the farmer when he is done with them than when he took them, so long is there need for speaking out upon this subject.

How shall man prevent the disaster of soil depletion? By one of those wonderful provisions of nature, the elements of earth's products that are essential to the growth of these products, after having been utilized for the purposes intended, are thrown aside as *waste*, and are available for use again. All that is required of man is to *pick up this waste and return it to the soil.*

Nature has provided a superabundance of this plant-food in the soil, so that while the necessary amount required for plants and waste is absent, the soil may continue to produce; and possibly to provide in a reasonable degree against the ignorance or thriftlessness or mistakes of man.

This superabundance is the margin that nature always provides—that important reserve that is one of the greatest laws in the economy of nature.

To profit by this margin, and—because the soil for a time responds to the calls upon it—to idly neglect to return to the soil its need and due is to mistake a merciful provision of nature, and to abuse a kindness. On the other hand, to be careful to return to the soil all the essential elements of soil-production, is to intelligently and rightfully interpret nature; it is to profitably make the earth a manufactory of wonderful products, for which she uses as raw material what is for any other purpose waste, and only waste. It is to provide for the life and feeding and comfort of the people of earth, now and in coming generations.

If this be true, the farm-boy, whose range is from barn-yard to field, whose dress and tools, suited to his labor, are heavy boots and four-tined fork, whose labor is neither light nor odorous, has a calling the nobility of which is befitting the dignity of the wisest and best. He is a servant of humanity and a benefactor of his race. By virtue of his labor the multitude are fed. Without his labor the plenty of to-day would be famine to-morrow.

Does he know the meaning of his vocation, and does he know how noble and high is his calling; or does he disparage himself and envy the existence of the dude, whom he has to feed, and who is like the lily in that he neither toils nor spins, but unlike the lily in that he has not even the merit of beauty as a reason for existence. Let us have fair and true understanding of this matter.

"The man who continually gathers from the soil and returns nothing to it until he can gather no more, changing a fertile smiling land into a sterile wilderness, impoverishes himself, wrongs his country, and beggars his children." (Bruckner).

"The day will come when this raw material (stable manure) of future crops will be considered as worthy of a store-house as the crop itself." (Bruckner).

"Different manures affect the proportion of grasses, and the different species of grasses are thus increased or diminished.

"The use of manures increases the crop of hay, influences the kinds of grasses; and the character of the weeds is also determined by the food supplied." (Rothamsted Experiments).

Manure must not be left too dry and allowed to heat and burn. It must be kept moist. It may contain all the liquid manure or water it can absorb without leaching. Manure should be sheltered to prevent leaching by rains.

"Wheat, barley, oats, corn, potatoes, buckwheat, turnips, beets, carrots, cabbage, hay, and crops of all kinds, if sold, will remove more plant-food from the farm than milk. Of all animal products, milk takes most plant-food from the farm and butter least."—*Amer. Agr*).

Ashes. Wood ashes contain about ten per cent. of potash, three per cent. of phosphoric acid, with thirty or forty per cent. of lime. Leached wood-ashes contain only about one per cent. of potash, about one and one-half per cent. of phosphoric acid, and thirty or forty per cent. of lime. They are of much value as a fertilizer, and excellent as a disinfectant.

Muck. Muck is a dark-brown earth that has collected in bogs and other wet places. It is the remains of plants that have undergone partial decomposition.

Muck is rich in vegetable matter, and possesses sufficient value as a fertilizer to pay for digging it and hauling a considerable distance.

Muck, when dry, is also an absorbent, and may be used to absorb and save liquid manure. The immediate value of muck as a fertilizer is increased by mixing with manure.

Muck, when first dug, is not in the best condition for use either as an absorbent or a manure. It needs to be dried for the first purpose, and sweetened for the second. To "make" it, or bring it into condition, it should be left exposed to the air about a year. Let it be dug at the most convenient season when the muck-bed is dryest; and remove to the nearest place. When it has "weathered," about a year, remove and store it near the stable where required.

The air and frost will change the soggy, heavy, useless mass to a dry, light, absorbent fertilizer.

Muck has a great value composted with ashes. Two-thirds muck and one-third stable-manure make an excellent fertilizer. Throw a quantity of muck on the droppings of the cow stable, once or twice a week, and use for top-dressing grass land in the fall.

Plant-food has to be restored even to pasture-land, because of the fact that in the milk and growth of animals there is carried away from the land more than is returned to it. Pasture land does not differ from other land in the fact that to take away from it without adding thereto must in time exhaust it. The exhaustion is perhaps more slow in pasture than in grain fields, because the balance against it is less, but it is sure. This loss in pasture must be made up. Manure, natural or chemical, must be applied. As the pasture cannot be ploughed, the manure must be applied as a top-dressing.

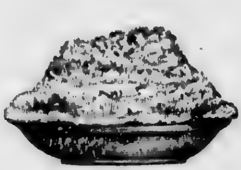
Food for Manure. Unquestionably, many foods have a large manurial value to be spread upon the soil in a raw state. Cotton-seed, cotton-seed cake, malt-sprouts bran, corn, all have a manurial value, in some cases possibly equal to their cost. One frequently hears them recommended as manure. Such use of food, however, is not economical.

Everything that has a food value, gives a feeding-waste that also has manurial value.

In some cases the manurial value is almost as great as before feeding. It is so, for instance, with cotton-seed cake and bran. Better economy than to apply food as a fertilizer is to feed it out to cattle, and *carefully save* the manure excreted. Where food by reason of excess and cheapness cannot be all profitably used as food, it may be economically used for a fertilizer. But where it has a food value that makes it worth feeding, it is most economical to make it serve both as food and manure.

Advantages of Underdraining. "Underdraining prevents drought; renders soil earlier in spring; warms the lower portions of the soil; prevents the grasses from running out; allows work to be done sooner after rains; improves the mechanical texture of soils; prevents in a great measure grass and winter grains from being winter-killed; prevents the throwing out of grain in winter; furnishes an increased supply of atmospheric fertilizers; keeps off the effects of cold weather longer in the fall; accelerates the distintegration of the mineral matters in the soil; enables the surface soil to be deepened by removing excess of water; causes the poisonous excrementitious matters of plants to be carried out of reach of their roots.

"Underdraining causes a more even distribution of nutritious matters among those parts of the soil traversed by roots; it prevents the formation of acetic and other acids, which induce the growth of sorrel and other weeds; it prevents the formation of so hard a crust on the surface of the soil as is customary on heavy lands; it prevents, in a great measure, the evaporation of water, and the consequent abstraction of heat from the soil; it admits of fresh quantities of water from rains, etc., which are always more or less imbued with the fertilizing gases of the atmosphere, to be deposited among the absorbent parts of the soil, and given up to the necessities of plants."



Aeration ....
Agriculture .
Ailments ...
Apron, Dairy
Artificial Bu
Ashes.......
Atmosphere,
Brand ......
Breeding ...
Breeds......
Brine.......
Brine-Salting
Butter .....
Butter-Makin
Butter, Reno
Butter, Tinn
Butter-Valu
Butter-Moul
Butter-Hold
Butter-Work
Caseine ....
Carding Cow
Cellars ....
Centrifugal
Cheaper Pro
Cheese-Fact
Cheese-Valu
CHURNING,
Stopping
Separation
Washing
Low Tem
Liquid in
Brine-Wa
Removing
Washing
Churning .
Preparin
Rules for
Filling C
Coloring
Agitatio
Ventilat
How Fr
Slow Ch
Churnin
Old Pra
Improve
Churns ..
Size...
Materia
Ventila
Points
CLEANLI
Cleansing
Coloring
Competiti
Condens
Cooling
Coöpera
Corn...
Corn Fe
Cost of
Cotton-s
Cow, Th
Cow Ho

INDEX.

- Aeration 9
- Agriculture 83
- Ailments 87
- Apron, Dairy—Milking 37, 74
- Artificial Butters 41, 82
- Ashes 101
- Atmosphere, Pure 11
- Brand 46
- Breeding 96
- Breeds 96
- Brine 28
- Brine-Salting 28
- Butter 6
- Butter-Making 6
- Butter, Renovating 48
- Butter, Tinned 80
- Butter–Value 94
- Butter-Moulds, &c. 37, 66
- Butter-Holder 65
- Butter-Worker 65
- Caseine 7
- Carding Cows 100
- Cellars 49
- Centrifugal System 15, 76, 79
- Cheaper Production 84
- Cheese-Factories 58, 79
- Cheese-Value of Milk 94
- CHURNING, GRANULAR PROCESS 23-30
  - Stopping Churn 24
  - Separation of Butter-milk 24
  - Washing Butter 25
  - Low Temperature 25, 28
  - Liquid in Abundance 26
  - Brine-Washing 25
  - Removing Butter 27
  - Washing Churn 30
- Churning 20
  - Preparing Churn 22
  - Rules for Time 21, 30
  - Filling Churn 22
  - Coloring 22
  - Agitation 22
  - Ventilation 22, 64
  - How Frequent 30
  - Slow Churning 31
  - Churning Whole Milk 77
  - Old Practice 23
  - Improved System 23
- Churns 62-65
  - Size 65
  - Material for 65
  - Ventilation 22, 63, 64
  - Points of Merit 63
- CLEANLINESS 5
- Cleansing Utensils 5, 67-69
- Coloring 22
- Competition 83-85
- Condensed Milk 81
- Cooling Milk 10, 11, 14, 15
- Coöperative Dairying 77
- Corn 98
- Corn Fodder 98
- Cost of Production 84
- Cotton-seed Meal 99
- Cow, The 88, 89
- Cow House, Rules for 97
- CREAM. 6, 18-19, 29
  - Consistency of 19
  - Ripening 18-19
  - Tempering 20-21
  - Defects in 29
  - Sweet *vs.* Sour 19
  - Churning Quality of 21, 86
- Cream-Dippers 62
- Creamers 11, 61
- Creameries 58, 78-79
- Creaming 7, 14
- Cream-Holder 20, 62
- Creamometer 76
- Cream Temperer 77
- Cream-Rising 7-11
- DAIRY, THE 49-58
  - Place Adapted 49
  - Location 53
  - Floor 50, 56, 57
  - Walls and Ceiling 51
  - Frame 57
  - Dead-Air Spaces 55, 57
  - Pantry Dairy 51
  - Out-Door Dairy 51
  - Cheap Milk-House 52
  - Mr. Mulock's Dairy 52
  - Model Dairy Building 56
  - Cost 58
- Dairy Science 3
- Dampness and Mould 54-55
- Delaiteuse 76
- Devonshire Cream 77
- Diagrams 2, 12
- Diet, Changes in 99
- Drainage 50, 56
- Ensilage 98
- Equivalents 99
- Exercise 100
- Experiments 8, 13, 77
- Factories 58, 78, 79
- Fertilizing Lands 101
- Filtration of Water 72
- Firkins, Butter 39
- Flavor 45, 48
- Food for Manure 102
- Foot Wear 75
- "Gathering" Butter 23
- Globules, Fat 7
- Grades 95
- Grain 28
- GRANULAR BUTTER 22
- GRANULAR CHURNING 23-24
- Heating Milk 10
- Herd-Books 90
- Holding Butter 47
- Ice-Houses 55, 72-74
  - Tools, &c. 74
- Illustrations—2, 16, 34, 37, 38, 59, 61, 62, 66, 74, 75, 76 (Covers.)
- Improvement of Stock 95
- Lactometer 13, 75
- MARKETING 40-48
  - Market Value—Increasing 3
  - Home Market 40, 48
  - Foreign or Export 41, 48
  - Suiting the Market 44

  Reputation 44
  Keeping up Connection 46
MILK 4, 85-86
  Management of 5
  An Absorbent 5
  Supply 81
  Butter-making Quality 6
  Creaming Quality 8, 11, 86
  Churning Quality 86
Milking 6, 87-88
  Regularity 87
  Complete 88
  Rapid 88
  Frequency 87
  Twice Daily 88
  Thrice Daily 88
Milk Products 3
Milk-Vessels 6, 60-62
Milk-Secretion 86
MILK-SETTING 7-15
  No Delay 9
  Shallow 11
  Deep 12, 14
  Arrest Changes 9
Moulds, Butter 37, 66
Muck 102
National Problem 83
Oleomargarine 41, 82
Packages 66-67
PACKING 34-40
  Slow Market 38
  Quick Market 36
  Table Shapes 36
  Return Packages 36, 38
  Solid 40
  Uniform 29, 40, 43
  For Checking 40
  Branding 40, 46
  Appearance 43
Packing Pestles 66
Painting 56, 58
Pans, Shallow 11
Pasture 97
Pedigree 89-91
Performance 89, 91
Plant-food 102
Points, Scale of 42
Potatoes 98
Practice, Profitable 3
PRESSING (and Salting) 32-34
  No Friction 32
  No Hand-Contact 32
Prices 41, 48, 80
Prints 66
Profitable Dairying 3
Pumpkins 98
Quality 4, 40
Records, Milk 91-95
Register Board 93
Registers 92, 93, 94
Registration 46, 90
Roots 98
SALT 34, 39
  In Cream 19
  Test of 34
Salt for Cows 99
SALTING 26, 34, 45
  Object of 33
  Quantity Required 33
  With Brine 28
  Cream Basis 27
  Well and Ill 34
  And Pressing 32
Saltpetre and Sugar 34
Sanitation 49-51
SCIENTIFIC PRACTICE 3
Seasoning 45
Selection 97
Shelter 87, 99
Silo 98
Sinks 5
Skim-Cheese Factory 79
Skim-Milk 6, 86
Skimming 7, 14
Soiling 97
Stables, Confined Air in 4
Steam-Power 76
Storage 48
Strainers 62
Succulent Food 97
Supplies 58-77
Supply, The 81
Tables 12, 42, 43, 60 (Cover)
Tanks 62
Testing 13, 59, 72, 94
Temperature 7, 8, 19, 21, 25, 28, 33, 59
Thermometers 7, 59, 75
Trade System 47
Tubs, Butter 38-39
Underdraining, Advantages of 102
Utensils (and Supplies) 58-77
Ventilation 4, 51, 54, 64, 73
WATER 4, 30, 55, 69, 72
  Pure Water 4, 30
  Sources of 70
  Wells, Springs 70
  Rain Water 71
  River Water 71
  Marsh Water 71
  Lead Pipes 71
  How to Purify 72
  Boiling Water 72
  Filtering Water 72
Watering Cows 100
WASHING UTENSILS 5, 67-69
Wheat Straw 98
Whitewash Paint 56
WINTER DAIRYING 81-82

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...92, 93, 94
.......46, 90
.... 98
........34, 39
.... 19
.... 34
.... 99
...26, 34, 45
.... 33
.... 33
.... 28
.... 27
.... 34
.... 32
.... 34
.........49-51
.... 3
.... 45
.... 97
.....87, 99
.... 98
.... 5
.... 79
.........6, 86
.......7, 14
.... 97
.... 4
.... 76
.... 48
.... 62
.... 97
.........58-77
.... 81
3, 60 (Cover)
.... 62
13, 59, 72, 94
25, 28, 33, 59
.....7, 59, 75
.... 47
.........38-39
.... 102
.........58-77
, 54, 64, 73
30, 55, 69, 72
.........4, 30
.... 70
.... 70
.... 71
.... 71
.... 71
.... 71
.... 72
.... 72
.... 72
.... 100
.....5, 67-69
.... 98
.... 56
.......81-82

In the above illustration are represented BUTTER *in fine grains, compared with* WHEAT; SAGO, TAPIOCA, PEAS, *and* MARBLES, *all in the order named. The butter-grains are smaller than anything beneath them;—so small, indeed that photography has made them look like snow, instead of like sand, as they actually appeared to the eye. The above is given to show in how fine grains it is possible to wash butter in the churn. The grains as above are finer than required in general practice; where they may have an appearance something like the cut on the* OUTSIDE OF FRONT COVER.